



US006490785B1

(12) **United States Patent**  
**Kometani**(10) **Patent No.: US 6,490,785 B1**  
(45) **Date of Patent: Dec. 10, 2002**(54) **MANUFACTURING APPARATUS OF WIRE HARNESS**(75) **Inventor: Toshio Kometani, Nagoya (JP)**(73) **Assignees: Autonetworks Technologies, Ltd., Aichi (JP); Sumitomo Wiring Systems, Ltd., Mie (JP); Sumitomo Electric Industries, Ltd., Osaka (JP)**(\*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.(21) **Appl. No.: 09/391,196**(22) **Filed: Sep. 7, 1999**(30) **Foreign Application Priority Data**

Dec. 9, 1998 (JP) ..... 10-349947

(51) **Int. Cl.<sup>7</sup> ..... B23P 19/00**(52) **U.S. Cl. .... 29/742; 29/33 M; 29/593; 29/622; 29/748; 29/753; 29/850; 29/861; 29/866; 29/868; 73/9; 73/862.01; 73/865.9**(58) **Field of Search .... 29/33 M, 748; 29/866, 868, 742, 593, 622, 850, 861, 753; 73/9, 862.01, 865.9**(56) **References Cited****U.S. PATENT DOCUMENTS**

3,930,524 A \* 1/1976 Tarbox ..... 140/93  
 4,043,017 A \* 8/1977 Folk et al. .... 29/749  
 4,043,034 A \* 8/1977 Sucheski et al. .... 29/749  
 4,375,229 A \* 3/1983 Mikami ..... 140/102  
 4,669,182 A \* 6/1987 Ferroni ..... 29/622  
 4,976,294 A \* 12/1990 Kudo ..... 140/102  
 5,119,546 A \* 6/1992 Cameron ..... 29/748  
 5,156,557 A \* 10/1992 Okafuji ..... 439/404  
 5,224,251 A \* 7/1993 Cameron ..... 29/33  
 5,289,633 A \* 3/1994 Okafuji ..... 29/850  
 5,345,978 A \* 9/1994 Okafuji ..... 140/92.1

5,396,053 A \* 3/1995 Swartz ..... 235/462  
 5,499,443 A \* 3/1996 Ota ..... 29/741  
 5,611,141 A \* 3/1997 Takada et al. .... 29/861  
 5,745,975 A \* 5/1998 Heisner et al. .... 29/564.6  
 5,774,981 A \* 7/1998 Maejima ..... 29/861  
 5,774,983 A \* 7/1998 Maejima ..... 29/881  
 5,791,037 A \* 8/1998 Takada et al. .... 29/566.3  
 5,913,469 A \* 6/1999 Suzuki ..... 226/36  
 5,970,609 A \* 10/1999 Shioda ..... 29/861  
 6,021,566 A \* 2/2000 Ohta ..... 29/863  
 6,170,152 B1 \* 1/2001 Ohta ..... 29/747

**FOREIGN PATENT DOCUMENTS**

EP 0 390 080 A1 10/1990  
 EP 0 833 416 A2 4/1998  
 EP 0 833 416 A3 11/1999  
 JP 09283254 4/1996  
 JP 10-241473 9/1998

\* cited by examiner

*Primary Examiner—Peter Vo**Assistant Examiner—Paul D Kim*(74) *Attorney, Agent, or Firm—Oliff & Berridge, PLC*(57) **ABSTRACT**

In a manufacturing apparatus of a wire harness in which pallet P, on which a plurality of connectors C are juxtaposed, is moved by a pallet feeding section 1 and a pressure-contact terminal of connector C is automatically positioned at a pressure-contact position under a pressure-contact head section 4, an electric wire "a" is automatically set at a pressure-contact terminal of connector C by an electric wire supply section 2 and an electric wire setting section 3, and cover L is automatically set on connector C by a cover mounting section 5. A type and position of the electric wire "a" to be arranged and the height of press-fitting of the electric wire into the pressure-contact terminal are controlled by a program, and the operation and state are checked by a sensor.

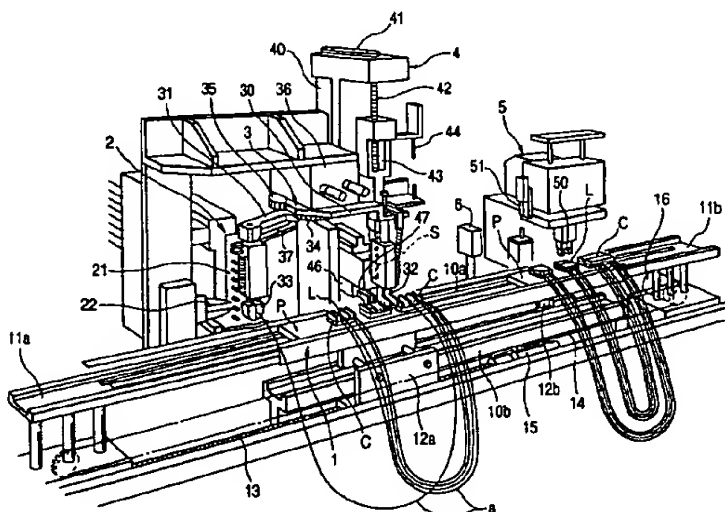
**7 Claims, 8 Drawing Sheets**



FIG. 2

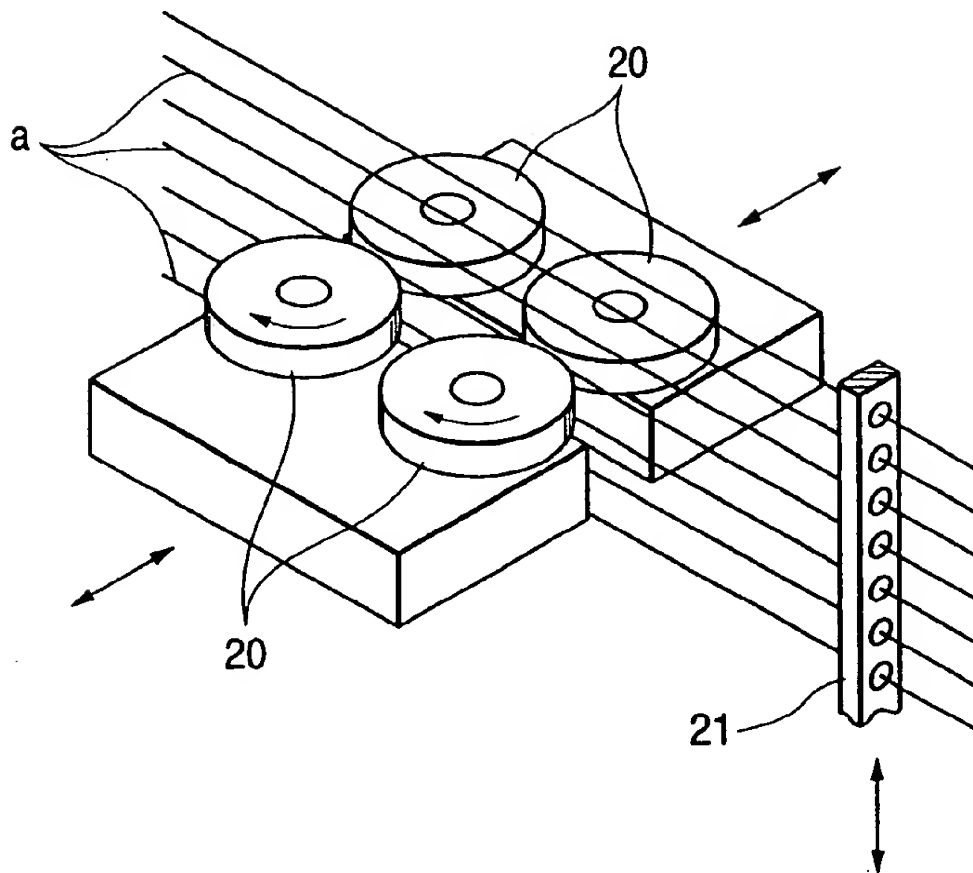


FIG. 3A

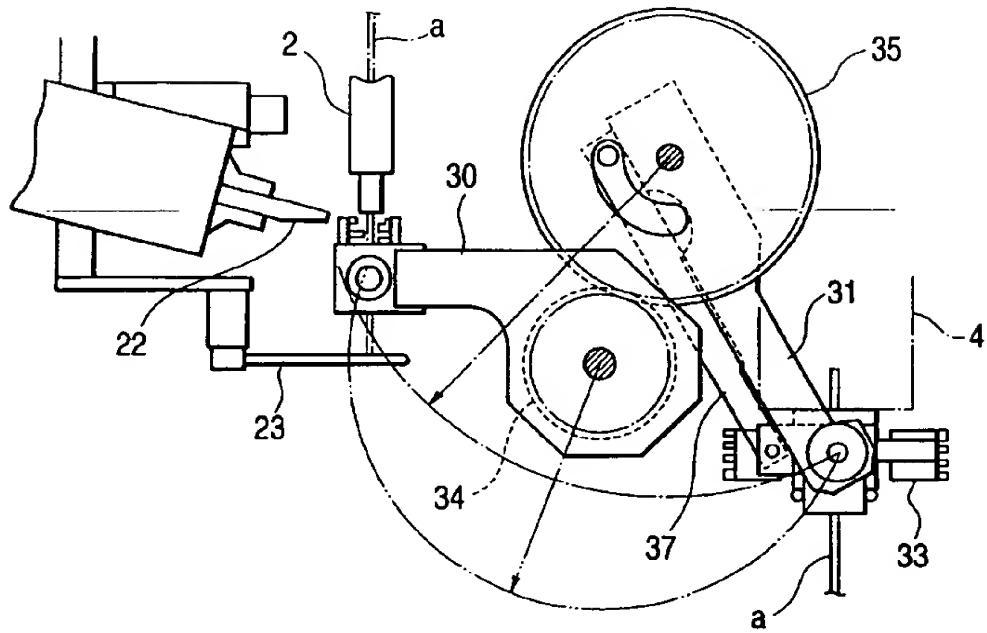
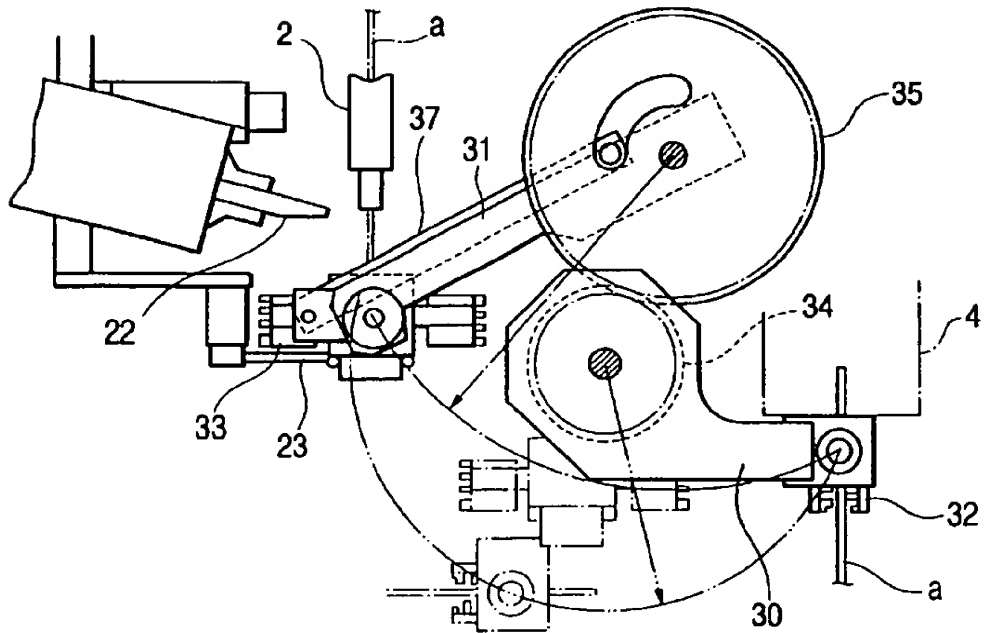
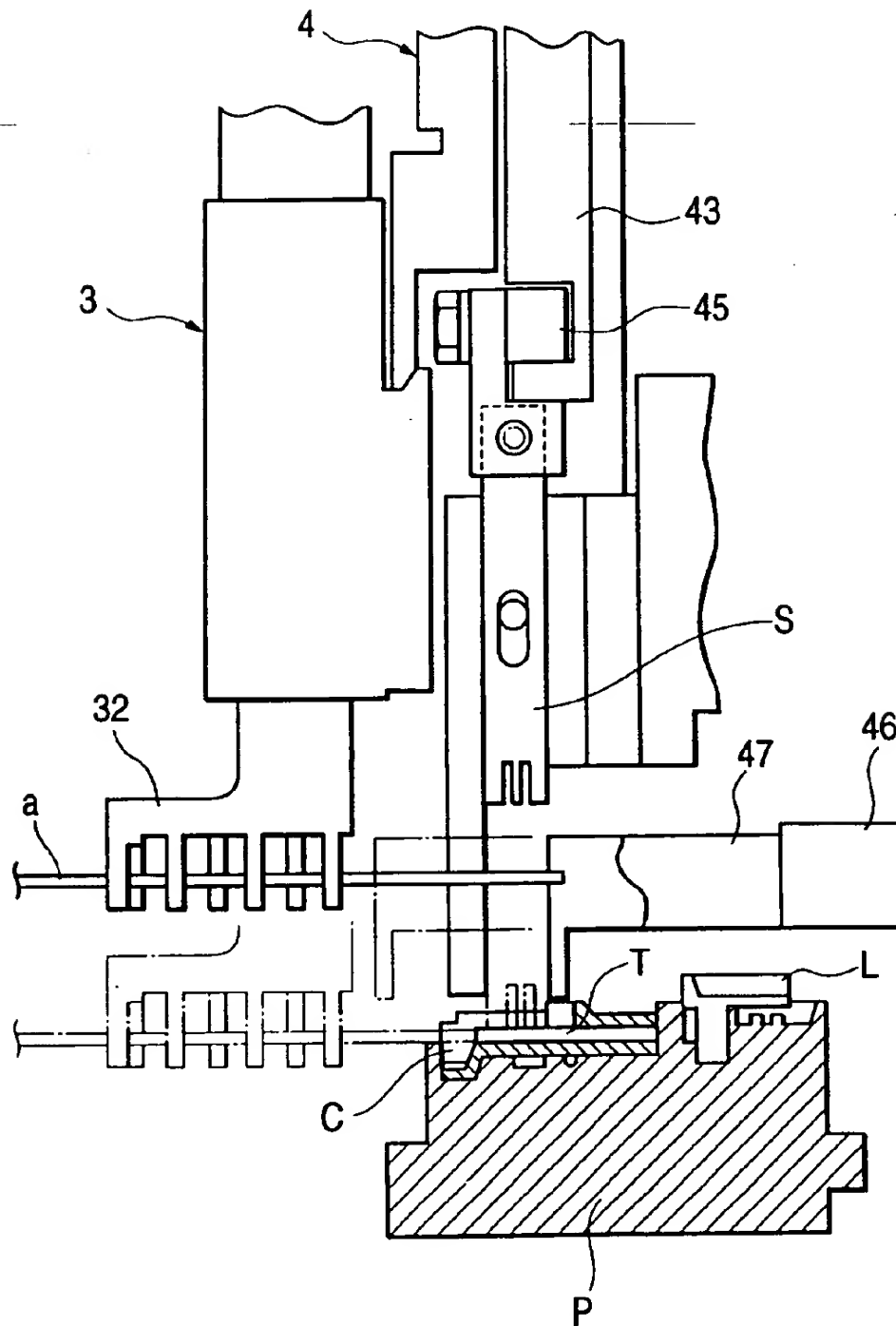
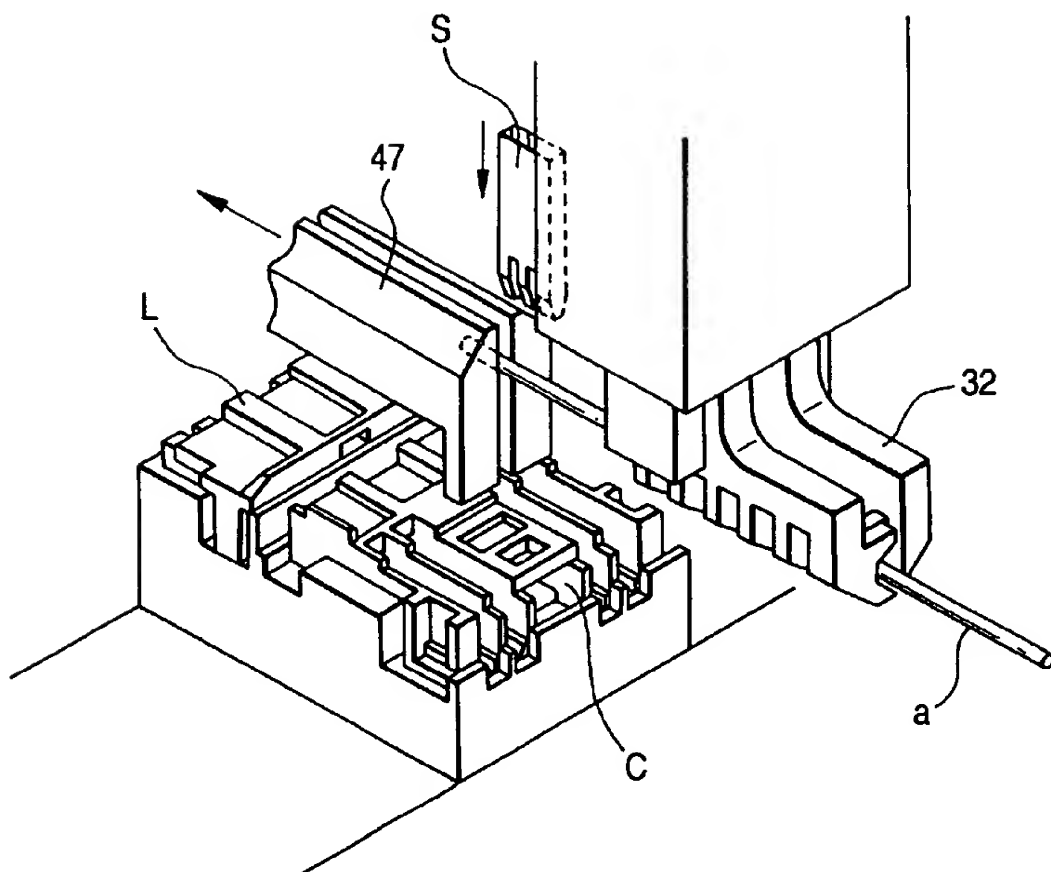
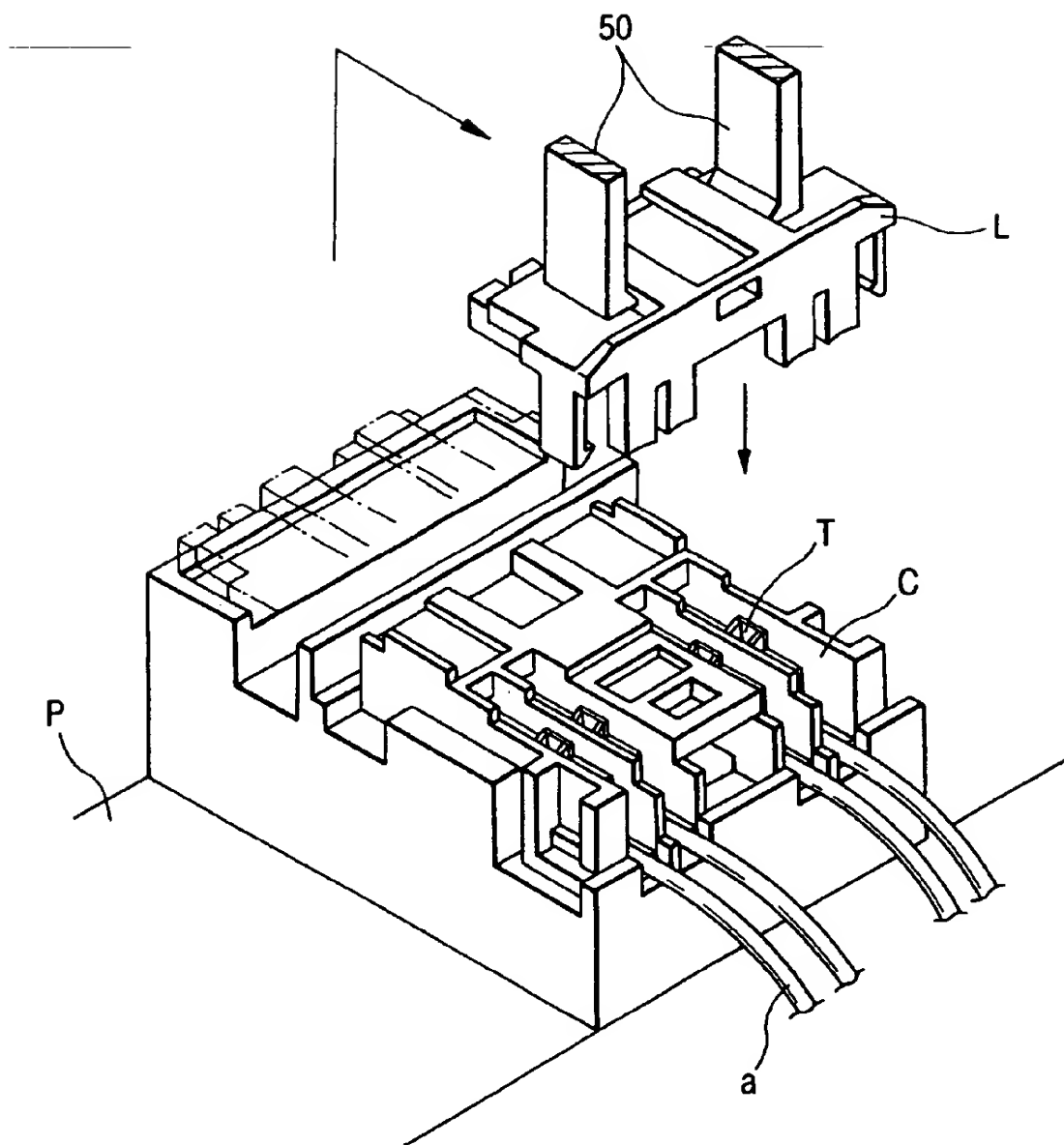


FIG. 3B



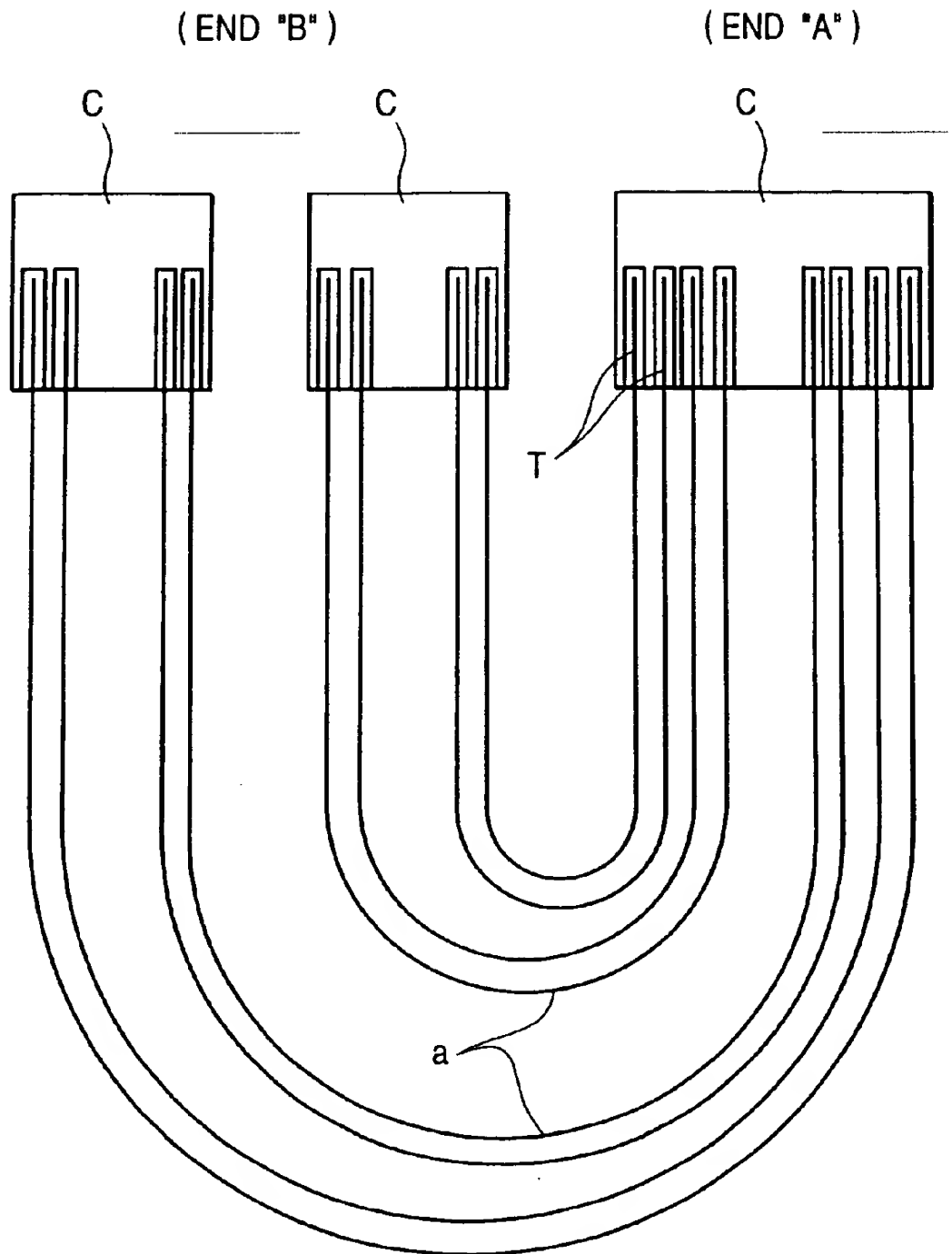
*FIG. 4*

*FIG. 5*

*FIG. 6*

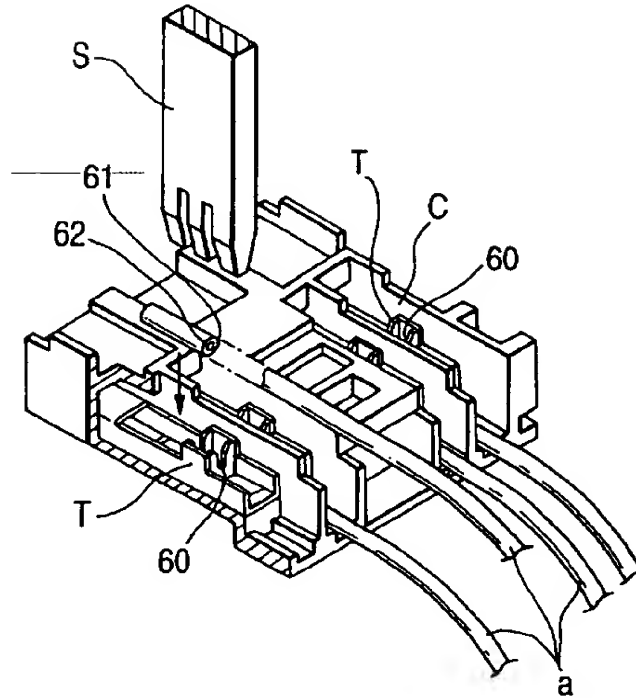
# FIG. 7

## PRIOR ART

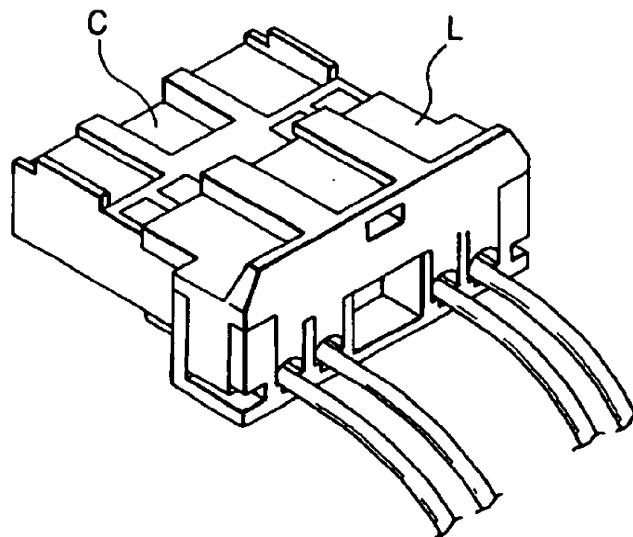




**FIG. 8**  
PRIOR ART



**FIG. 9**  
PRIOR ART



## MANUFACTURING APPARATUS OF WIRE HARNESS

### BACKGROUND OF THE INVENTION

The present invention relates to a manufacturing apparatus of a wire harness for automobile use.

FIG. 7 is a view showing an example of a wire harness for automobile use in which connectors are attached to both end portions of wires arranged in parallel to each other. At one end of this wire harness, which will be referred to as end A hereinafter, eight pieces of electric wires "a" are connected to one connector C. At the other end of this wire harness, which will be referred to as end B hereinafter, four pieces of electric wires "a" are respectively connected to two connectors C.

In order to enhance the working efficiency of connection, insulation displacement connection (pressure-contact connection) is applied to the means for connecting electric wire "a" to connector C as shown in FIG. 8. This insulation displacement connection is conducted as follows. Electric wire "a" is pushed downward by pressure-contact blade S and press-fitted into a groove 60 of pressure-contact terminal T provided in each connector C. When electric wire "a" is press-fitted into the groove 60, a insulation cover 62 covering a conductor bundle 61 of electric wires "a" is cut off at an end edge of the groove 60, so that the conductor bundle 61 is exposed outside. This conductor bundle 61 is contacted with pressure-contact terminal T. and at the same time, electric wires "a" are held in the groove 60 by the spring-back action of pressure-contact terminal T. After electric wires "a" have been press-fitted into pressure-contact terminal T, connector C is covered with terminal cover L as shown in FIG. 9, so that electric wires "a" can be prevented from coming off.

In this connection, Japanese Unexamined Patent Publication 10-241473 discloses an apparatus used for the above pressure-contact connection in which the pressure-contact terminals of the connector are positioned at pressing positions of the contact-pressure apparatus when the pallets, on which predetermined connectors are juxtaposed, are moved. In this apparatus, electric wires are manually supplied to the pressure-contact terminals and also the terminal cover is manually attached to the connector.

However, when the above apparatus is used, there is a possibility that the electric wires are mistakenly supplied and erroneous wiring is made. Further, it takes time to select the electric wires and attach the terminal cover. Therefore, it is impossible to improve the productivity.

### SUMMARY OF THE INVENTION

The present invention is accomplished to solve the above problems. It is an object of the present invention to prevent the occurrence of erroneous electric wiring and enhance the productivity when the wire harness is manufactured.

In order to solve the above problems, the present invention provides a manufacturing apparatus of a wire harness in that: a pallet in which a plurality of connectors are juxtaposed is automatically positioned at a pressure-contact position; wiring of an electric wire in the pressure-contact terminal of the connector is automatically conducted; and a cover is automatically attached to a connector.

When a type, position and height of press-fitting of an electric wire into the pressure-contact terminal are controlled according to a program, and the operation and state are checked by sensors.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an overall perspective view showing an embodiment of the present invention;

FIG. 2 is a perspective view showing an outline of an electric wire supply section of the above embodiment;

FIG. 3A is a plan view showing a state of an electric wire setting section of the above embodiment;

FIG. 3B is a plan view showing another state of an electric wire setting section of the above embodiment;

FIG. 4 is a right side view of a lower portion of a pressure-contact head section of the above embodiment;

FIG. 5 is a perspective view showing an outline of the operation of a curled wire straightening chuck of the above embodiment;

FIG. 6 is a perspective view showing an outline of the operation of a cover mounting section of the above embodiment;

FIG. 7 is a plan view showing an example of wire harness;

FIG. 8 is a perspective view showing pressure-contact of an electric wire with a connector terminal; and

FIG. 9 is a perspective view showing a connector to which a terminal cover is attached.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the appended drawings, an embodiment of the present invention will be explained as follows. As shown in FIG. 1, this manufacturing apparatus of manufacturing a wire harness comprises: a pallet supply section 1, electric wire supply section 2, electric wire setting section 3, pressure-contact head section 4, and cover mount section 5.

The pallet supply section 1 includes: an upper and a lower guide rail 10a, 10b for guiding pallet P on which a plurality of connectors C are juxtaposed; two elevating mounts 11a, 11b, arranged on both sides of the guide rails 10a, 10b, for receiving and delivering pallet P between the guide rails 10a, 10b; and two carriages 12a, 12b for moving pallet P along the guide rail 10a or 10b. The carriage 12a is screwed to the screw shaft 13 by a ball screw structure, and the carriage 12b is attached to the endless belt 14 which is stretched between a pair of pulleys, and the carriages 12a and 12b are respectively driven by the servo motors 15, 16 so that they can travel along the guide rails.

As shown in FIGS. 1 and 2, the electric wire supply section 2 includes: two pairs of rollers 20 coming into contact with each other; and an elevating body 21 for elevating a large number of electric wires "a" to be put under the condition that they are juxtaposed in the vertical direction. By the motion of the elevating body 21, electric wire "a" to be contacted with pressure in the next place is positioned at a level of the roller 20 and held by the pair of rollers 20 and fed by a predetermined length. In the front of the electric wire supply section 2, there are provided shears 22 which proceed and retract with respect to a feeding hole of the electric wire "a", and there is also provided a support bar 23 which can be freely elevated.

As shown in FIGS. 1 and 3, the electric wire setting section 3 includes two rotary arms 30, 31. At ends of the two rotary arms 30, 31, there are provided an end A chuck 32 and an end B chuck 33 which respectively hold ends A and B of the electric wire "a". Gears 34, 35 arranged at the ends of the respective rotary arms 30, 31 are meshed with each other, and the respective rotary arms 30, 31 can be simultaneously rotated in the opposite direction by the same drive motor 36.

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In the process of rotation, the locus of the rotary arm 30 is different from that of the rotary arm 31. Accordingly, there is no possibility of interference of the end A chuck 32 with the end B chuck 33. In this case, a link 37, which composes a parallel crank mechanism together with the rotary arm 31, is connected to one side of the end B chuck 33. Due to the above structure, the end B chuck 33 can be directed to the same direction at all times.

The pressure-contact head section 4 is composed as follows. As shown in FIGS. 1, 4 and 5, when the servo motor 40 is driven, the screw shaft 42 is rotated via the belt 41. The elevating rod 43 is screwed to this screw shaft 42 by a ball screw mechanism. Due to the above arrangement, pressure-contact blade S arranged at a lower end of the elevating rod 43 is elevated. At the same time, when the elevating rod 43 is lowered, the end A chuck 32 or the end B chuck 33 is pushed downward. In this pressure-contact head section 4, there are provided a linear scale 44 for detecting the height of the elevating rod 43 from the reference position and a load cell 45 for detecting a reaction force of pressure-contact blade S.

At a lower position of the pressure-contact head section 4, there is provided a curled wire straightening device 46. This curled wire straightening device 46 includes: a curled wire straightening chuck 47 which is moved in the longitudinal direction while it is chucking an end portion of the electric wire "a" protruding from the end A chuck 32 or the end B chuck 33; and an opening and closing sensor not shown in the drawing.

As shown in FIGS. 1 and 6, the cover mounting section 5 includes a cover holding chuck 50 which is vertically elevated and moved in the longitudinal direction when it is driven by a cylinder. This cover mounting section 5 includes a linear scale 51 for detecting the height of the cover holding chuck 50 from a reference position.

For example, when the wire harness shown in FIG. 7 is manufactured by the above manufacturing apparatus of the wire harness, three connectors C corresponding to ends A and B of the wire harness and terminal cover L juxtaposed on pallet P on the elevating mount 11b located at the rising position, and the elevating mount 11b is lowered, and this pallet P is sent onto the elevating mount 11a, which is at a lowering position, via the guide rail 10b when the carriage 12b travels.

Then, the engagement of the carriage 12b with a pallet P is released, and the elevating mount 11a is raised and the carriage 12a is engaged with pallet P. According to the travel of the carriage 12a, pallet P is moved onto the guide rail 10a. In this way, terminal T of connector C with which the electric wire "a" is pressure-contacted for the first time is positioned under pressure-contact blade S of the pressure-contact head section 4. This positioning is conducted according to a program which is previously set.

Next, the first electric wire "a", which has been previously set according to the program, is a little fed out from the electric wire supply section 2, and its forward end portion is held by the end A chuck 32 as shown in FIG. 3A. While the electric wire "a" is further being fed out, the rotary arm 30 is rotated, and the end A chuck 32 is positioned in the front of the pressure-contact head section 4 of the end A chuck 32 as shown in FIG. 3B.

Feeding of the electric wire "a" is stopped, and a forward end portion of the electric wire "a" protruding from the end A chuck 32 is held by the curled wire straightening chuck 46 as shown in FIGS. 4 and 5, and this chuck 46 is retracted while it is slid on the cover of the electric wire "a" in the

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drawing direction. In this way, the curled electric wire "a" can be straightened.

At this time, whether or not the curled wire straightening chuck 46 holds the electric wire "a" is detected by the opening and closing sensor. Due to the above detection, whether or not the electric wire "a" is sufficiently protruded is judged by the program.

Successively, pressure-contact blade S of the pressure-contact head section 4 is lowered together with the end A chuck 32, and an end portion of the electric wire "a" is press-fitted into the groove of terminal T of predetermined connector C. The height of press-fitting is previously set at the most appropriate value by the control program of the servo motor 40. This height of press-fitting is measured by the linear scale 44, and the resistance of press-fitting is measured by the load cell 45. Then, a state of press-fitting is judged by the program.

In parallel with this pressure-contact connection, while the electric wire "a", which stops in front of the electric wire supply section 2, is being held by the support bar 23, it is held by the end B chuck 33, and the shears 22 are moved forward, so that the electric wire "a" is cut by a predetermined length at the rear of the end B chuck 33 as shown in FIG. 3B.

After end A has been connected by pressure-contact, the rotary arm 31 is rotated and the end B chuck 33 is positioned in front of the pressure-contact head 4, and the electric wire "a" is released from the end A chuck 32. Then, the rotary arm 30 is rotated in the opposite direction simultaneously with the rotary arm 31, so that the end A chuck 32 is positioned in front of the electric wire supply section 2 as shown in FIG. 3A. When pallet P is moved according to the setting of the program, terminal T of connector C of this electric wire "a" is positioned under pressure-contact blade S of the pressure-contact head section 4.

Next, when pressure-contact blade S of the pressure-contact head section 4 is lowered together with the end B chuck 33, a rear end portion of the electric wire "a" is press-fitted into a groove of terminal T of a predetermined connector C at end B. In the same manner as that on the side of end A, the height of press-fitting is previously set at the most appropriate value by the control program of the servo motor 40. When the press-fitting is conducted, the height of press-fitting is measured by the linear scale 44, and the resistance of press-fitting is measured by the load cell 45 so as to judge the state of press-fitting by the program.

While end B is being connected by pressure-contact, the electric wire supply section 2 feeds the electric wire "a" to be successively connected by pressure-contact. When the above pressure-contact connecting motion is repeatedly conducted on all electric wires "a", wiring shown in FIG. 7 is completed.

After that, the engagement of pallet P with the carriage 12a is released. Instead of that, the carriage 12b is engaged with pallet P, and this pallet P is moved to a position under the cover mounting section 5.

As shown in FIG. 6, terminal cover L is held by the holding chuck 50 and lifted up and moved forward. Then, terminal cover L is put on connector cover C. This operation is successively conducted on each connector C. In this way, the wire harness is completed.

When terminal cover L is attached as described above, the height of terminal cover L from connector C is measured by the linear scale 51 and compared with an allowed value by the program so that an attaching state of terminal cover L is judged. According to the result of judgment, only pieces of good wire harness are delivered as products.

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In this connection, after the electric wire "a" has been press-fitted and before terminal cover L is attached, the height of press-fitting of the electric wire "a" is measured by a laser sensor 6 (FIG. 1) and cover L is put on only connector C in which the heights of press-fitting of all electric wires "a" are in the allowance. Due to the foregoing, it is possible to save labor necessary for removing terminal cover L when a defective product is repaired.

According to the present invention, in a manufacturing apparatus of a wire harness in which a pallet, on which predetermined connectors are juxtaposed, is moved and automatically y positioned at a pressure-contact connecting position, wiring is automatically conducted on electric wires connected to pressure-contact terminals of the connector. Therefore, it is possible to prevent the occurrence of defective products which are made by erroneous wiring. Accordingly, the wire harness of stable quality can be effectively manufactured.

When types and positions of the electric wires to be arranged are arbitrarily selected in the above automatic wiring, it is easy to change the types and positions of the electric wires, so that various types of products can be effectively produced.

When the height of press-fitting of the electric wire into the pressure-contact terminal is arbitrarily set by the control program of the motor for press-fitting, it is possible to set the height of press-fitting at the most appropriate value at which the pressure-contact condition can be stabilized.

When the height of press-fitting is measured by the linear scale and the resistance of press-fitting is measured by the load cell so as to automatically y judge the press-fitting condition of the wire, it is possible to prevent the occurrence of defective products.

When the height of press-fitting is measured by the laser beam sensor after press-fitting of the electric wire and the terminal cover is set only on the connector in which the heights of press-fitting of all electric wires are in the allowance, it becomes unnecessary to remove the terminal cover when a defective product is repaired, that is, the defective product can be easily repaired.

When the height of the terminal cover is measured by the linear scale in the case of attaching the terminal cover to the connector so as to automatically y judge the cover attaching condition, it is possible to prevent the occurrence of a defective product in which the terminal cover is defectively attached to the connector.

What is claimed is:

1. A manufacturing apparatus of a wire harness comprising:

a pallet guide portion that automatically guides a pallet on which a plurality of connectors are juxtaposed;

an electric wire supply portion which automatically feeds an electric wire by a predetermined length;

an electric wire setting portion which automatically sets the electric wire on a pressure-contact terminal of one of said connectors;

a press contact portion which automatically press-fits said electric wire into the pressure-contact terminal of one of said connectors; and

a cover mounting portion which automatically sets a terminal cover on said one of said connectors, wherein

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a height of press-fitting is measured by a linear scale and resistance of press-fitting is measured by a load cell when the electric wire is press-fitted into the pressure-contact terminal, and a state of press-fitting of the electric wire is automatically judged.

2. A manufacturing apparatus of a wire harness according to claim 1, wherein a type and position of said electric wire to be set are arbitrarily selected according to a program when the electric wire is automatically set, and the electric wire is arranged one by one.

3. A manufacturing apparatus of a wire harness according to claim 1, wherein the height of press-fitting of the electric wire is arbitrarily set according to a control program of a motor used for press-fitting when the electric wire is press-fitted into the pressure-contact terminal.

4. A manufacturing apparatus of a wire harness according to claim 1, wherein a height of the terminal cover is measured by a linear scale when the terminal cover is set on the connector on the pallet, and a state of the cover is automatically judged.

5. A manufacturing apparatus of a wire harness according to claim 1, wherein said pallet guide portion comprises:

an upper guide rail and a lower guide rail, each guide rail separately guiding the pallet on which the plurality of said connectors are juxtaposed;

two elevating mounts arranged at opposite ends of said guide rails the elevating mounts transferring said pallet between said upper and lower guide rails; and

two carriages that move said pallet, each carriage moving said pallet along a respective one of the guide rails.

6. A manufacturing apparatus of a wire harness according to claim 1, wherein said press contact portion includes:

an electric wire supply section that supplies said electric wire;

an electric wire setting section that sets said electric wire on said pressure-contact terminal of said connector; and

a pressure contact head section that presses the electric wire into said pressure-contact terminal.

7. A manufacturing apparatus of a wire harness comprising

a pallet guide portion that automatically y guides a pallet on which a plurality of connectors are juxtaposed;

an electric wire supply portion which automatically feeds an electric wire by a predetermined length;

an electric wire setting portion which automatically sets the electric wire on a pressure-contact terminal of one of said connectors;

a press contact portion which automatically press-fits said electric wire into the pressure-contact terminal of one of said connectors; and

a cover mounting portion which automatically sets a terminal cover on said one of said connectors, wherein a height of press-fitting of the electric wire is measured by a laser beam sensor after the electric wire has been set and press-fitted into the connector on the pallet, and said terminal cover is set on only the connector in which the heights of press-fitting of all electric wires are within an allowable range.

\* \* \* \* \*



US005774983A

#1

**United States Patent** [19][11] **Patent Number:** 5,774,983**Maejima**[45] **Date of Patent:** Jul. 7, 1998[54] **METHOD OF INSERTING TERMINALS INTO HOUSING WITH SPECIAL ARRANGEMENT**5,459,924 10/1995 Ohsumi et al. .... 29/881  
5,515,601 5/1996 Maejima ..... 29/33 M X  
5,657,535 8/1997 Maejima ..... 29/748 X[75] **Inventor:** Takamichi Maejima, Haibara-gun, Japan**FOREIGN PATENT DOCUMENTS**

7-114969 5/1995 Japan .

[73] **Assignee:** Yazaki Corporation, Tokyo, Japan*Primary Examiner—Peter Vo**Attorney, Agent, or Firm—Armstrong, Westerman, Hattori, McLeland & Naughton*[21] **Appl. No.:** 745,612[57] **ABSTRACT**[22] **Filed:** Nov. 8, 1996[30] **Foreign Application Priority Data**

Nov. 10, 1995 [JP] Japan ..... 7-292803

[51] **Int. Cl.<sup>6</sup>** ..... H01R 43/20; H01R 9/16[52] **U.S. Cl.** ..... 29/881; 29/33 M; 29/748; 29/759[58] **Field of Search** ..... 29/33 M, 759, 29/748, 837, 845, 881[56] **References Cited****U.S. PATENT DOCUMENTS**4,967,470 11/1990 Folk ..... 29/748 X  
5,414,925 5/1995 Nishide et al. .... 29/748

A terminal is inserted randomly into a specially arranged housing with terminal receiving chambers arranged in staggered fashion, the terminal inserting method to a specially arranged housing 2 in which it allows leading electric wires 9 from the specially arranged housing 2 where terminal receiving chambers are arranged in the staggered fashion to push aside by a guide claw 3, wherein the guide claw 3 is entered along the bulkheads 5, 6 extending rectilinearly between columns of the terminal receiving chambers 1<sub>1</sub>, 1<sub>2</sub>, 1<sub>3</sub> of the specially arranged housing 2. An entering direction of the guide claw 3 is harmonized with the extending direction of the rectilinear bulkheads 5, 6 by 90°-turn-over of the specially arranged housing 2.

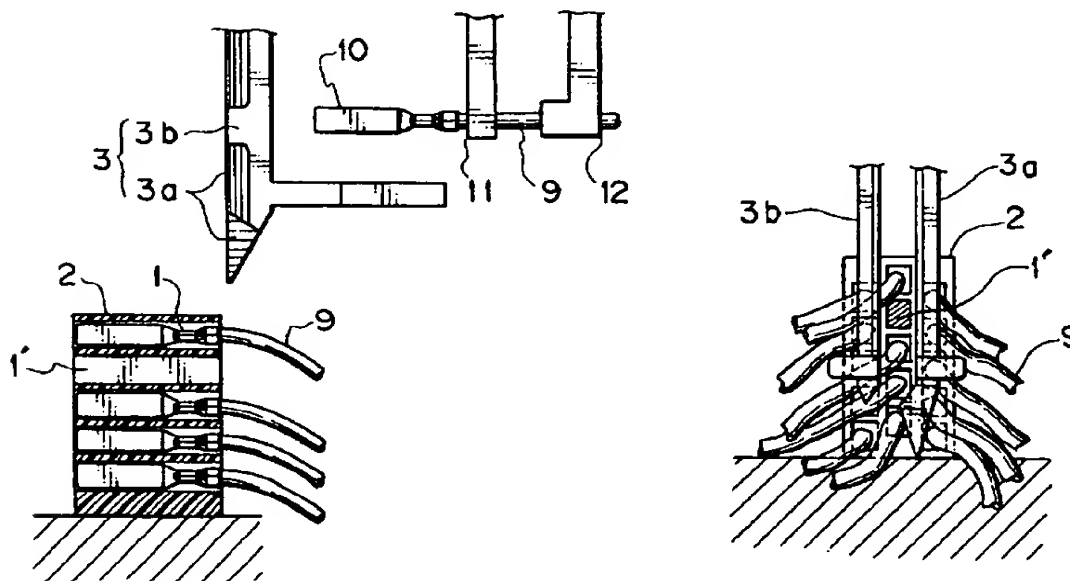
**4 Claims, 9 Drawing Sheets**

FIG. 1

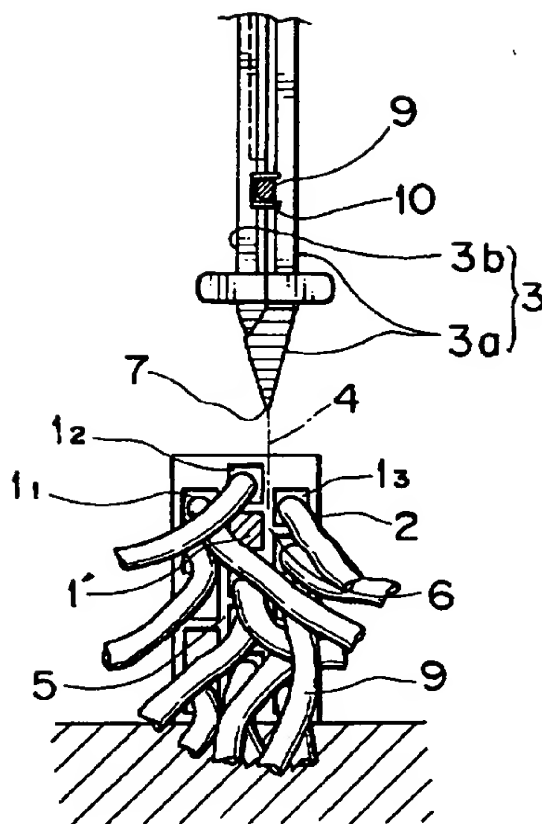


FIG. 2

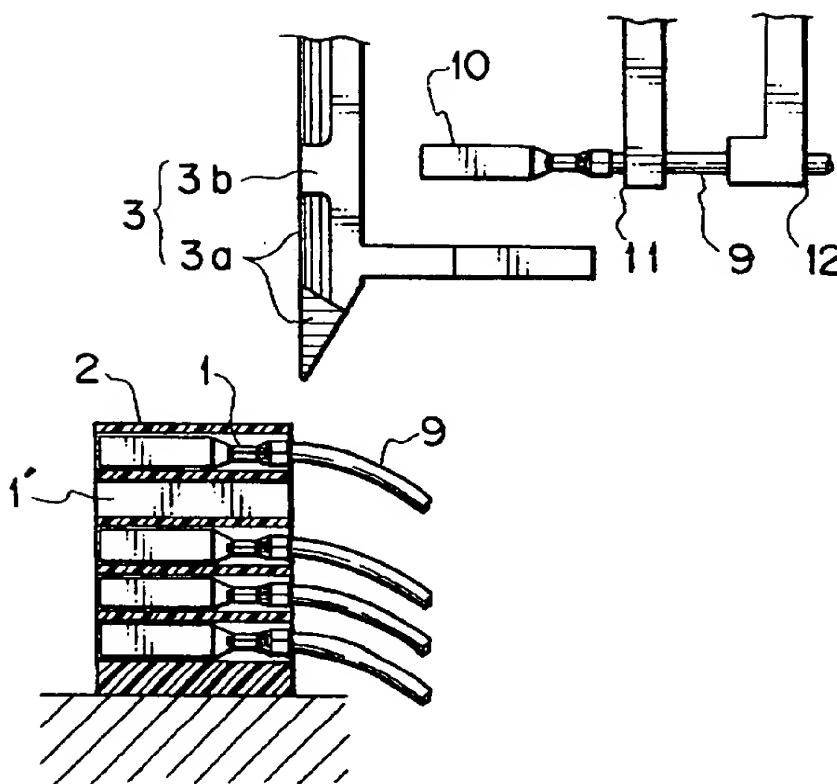


FIG. 3

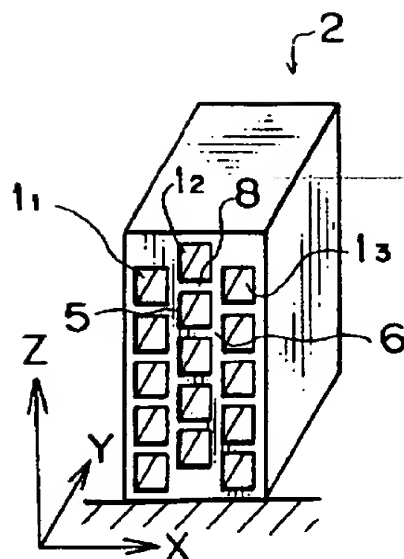


FIG. 4

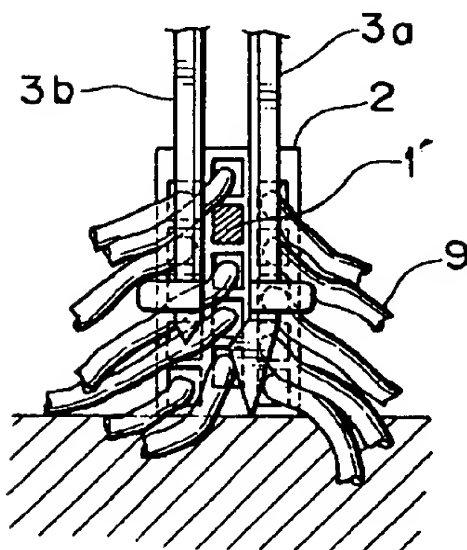




FIG. 5

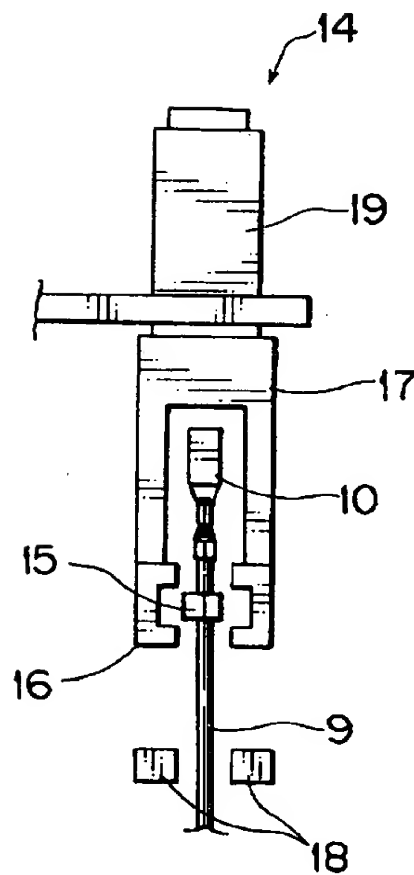


FIG. 6

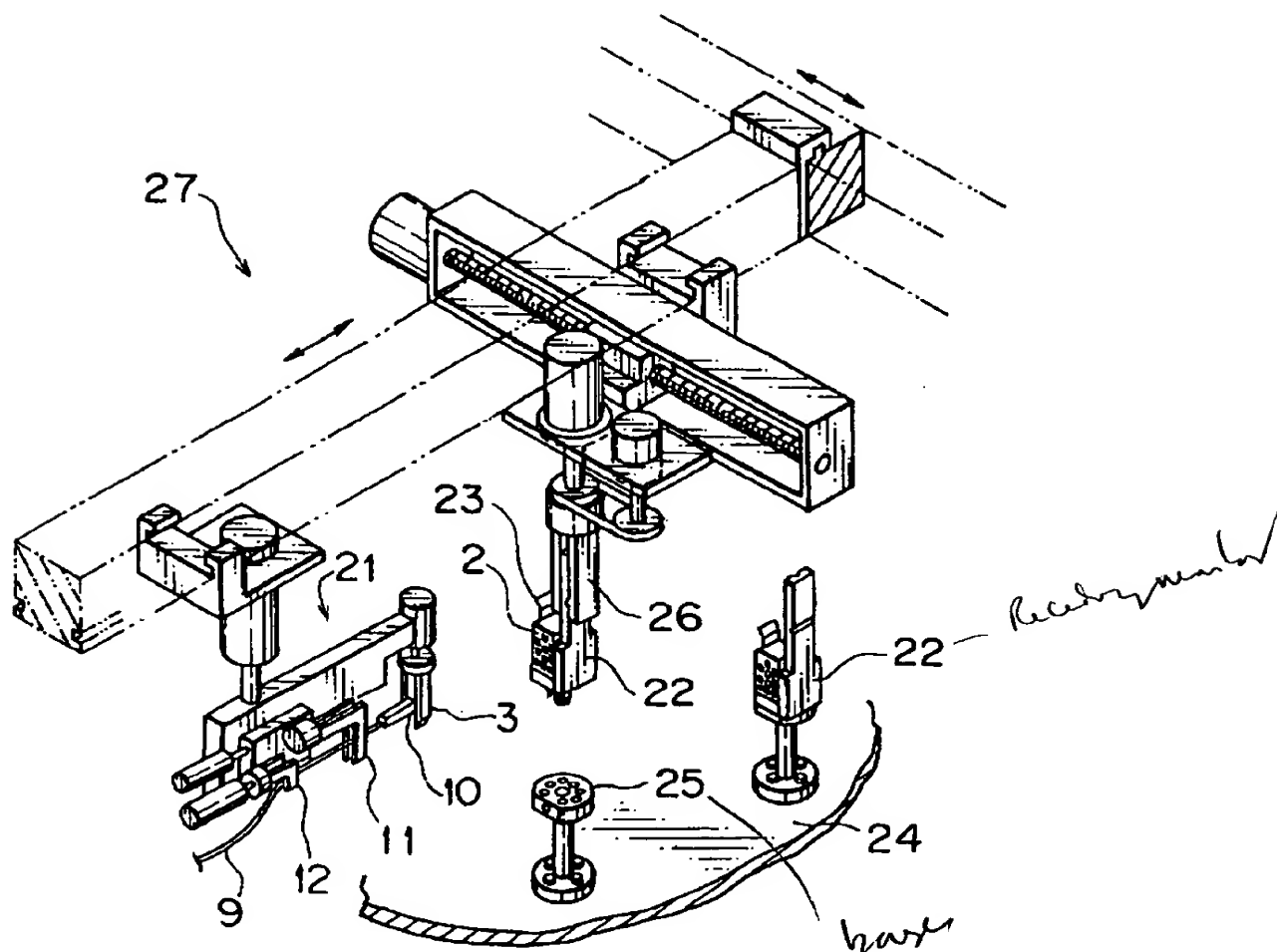


FIG. 7  
PRIOR ART

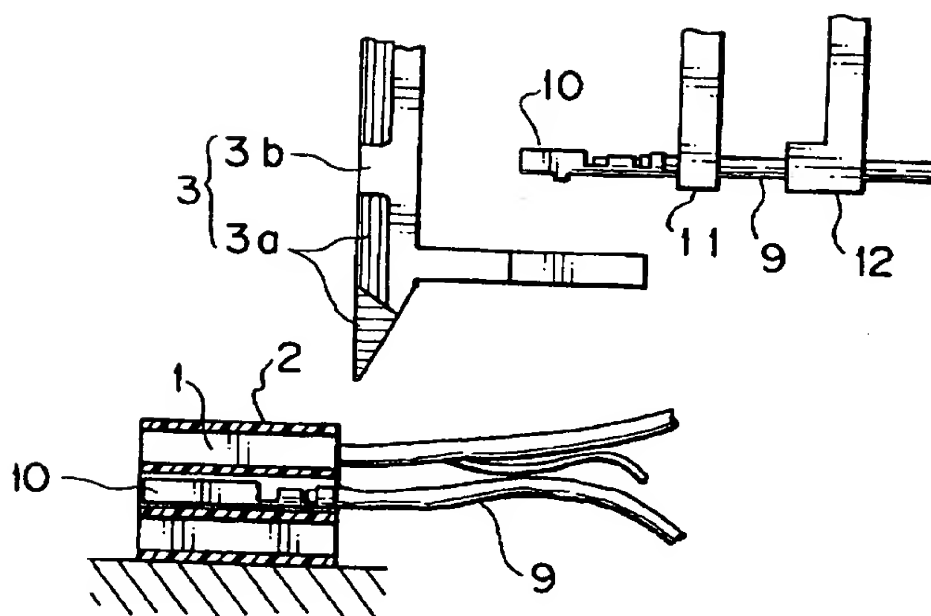


FIG. 8  
PRIOR ART

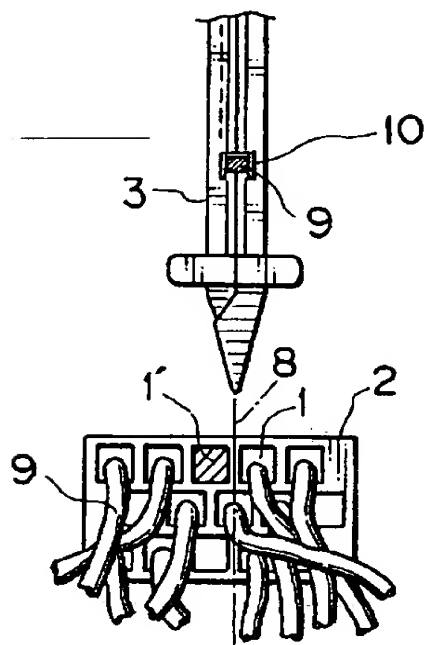


FIG. 9  
PRIOR ART

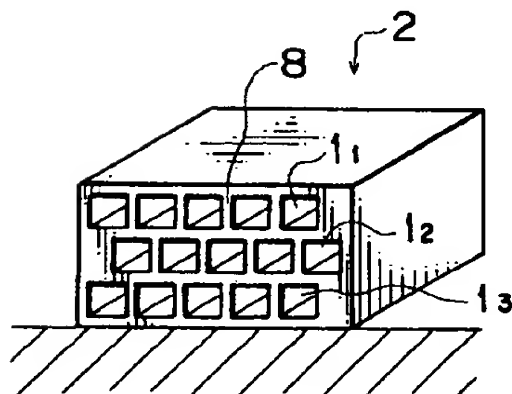


FIG. 10  
PRIOR ART

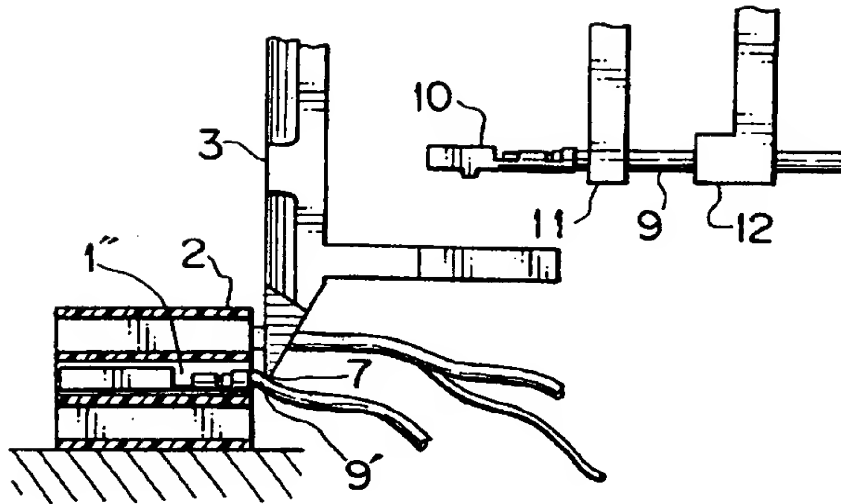
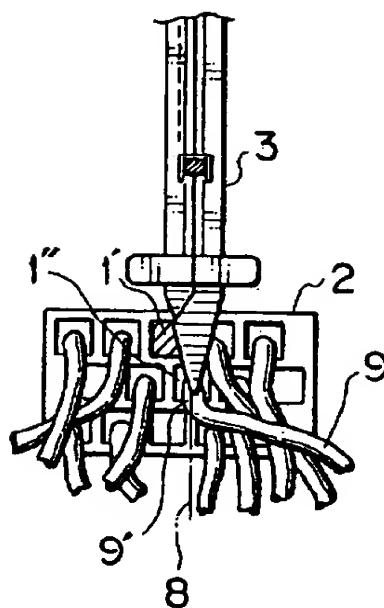


FIG. 11  
PRIOR ART



# METHOD OF INSERTING TERMINALS INTO HOUSING WITH SPECIAL ARRANGEMENT

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a method of inserting terminals into a housing with a special arrangement in which the method makes it possible for the electric wire, in the specially arranged housing having terminal receiving chambers arranged in staggered fashion, to be pushed aside and allows random insertion of the terminals.

### 2. Description of the Prior Art

FIGS. 7 and 8 show a conventional inserting method for a terminal which has been proposed in Japanese Patent Application Laid Open No. Hei 7-114969 by the applicant of the present application.

In the conventional inserting method for the terminal, a connector housing 2 is fixed in such a way that the connector housing 2 is placed in a lateral direction. Electric wires 9 with terminals are grabbed by a pair of grabbing claws 11, 12 in front of and behind the terminal inserting head. The terminals are inserted into the terminal receiving chamber 1 of the connector housing 2. A pair of guide claws 3a, 3b are integrally fluctuated with the grabbing claws 11, 12. An opening of the required terminal receiving chamber 1' is conserved due to pushing the derived electric wires 9 (already inserted into the electric wire 9 with terminal) aside by the pair of guide claws 3a, 3b. In this condition, the next terminal 10 is inserted by the grabbing claws 11, 12.

The pushing-aside operation by the guide claw 3 makes it possible for the terminal 10 to implement the random insertion to the required terminal receiving chamber 1'. In FIG. 8, reference numerals 10, 9 show the terminal and the electric wire, respectively to be inserted from this time forth.

However, as shown in FIGS. 8 and 9, when the specially arranged housing, having terminal receiving chambers arranged in staggered fashion, is used, as shown in FIGS. 11, 12, this introduces the derived risk of injury to the electric wire 9. If pushing the electric wire 9 aside allows the guide claw 3 to descend along the partition wall (side wall) of the required terminal receiving chamber 1' (the terminal 10 beginning to be inserted), the pointed end 7 of the guide claw 3 impinges on the derived electric wire 9 from the terminal receiving chamber 1' located downwardly of the partition wall 8. Thus, there is the derived risk of injury to the electric wire 9.

Consequently, for the specially arranged housing, the terminal 10 is forced to be inserted by hand. This is the main cause of obstructing the manufacture when it allows the wire-harness to manufacture automatically. As shown in FIG. 9, the specially arranged housing 2 has terminal receiving chambers 1<sub>1</sub>, 1<sub>2</sub>, 1<sub>3</sub> which are arranged in three columns of left, middle, and right. The partition walls 8 (side walls) of each of the left-column of the terminal receiving chamber 1<sub>1</sub> or right-column of the terminal receiving chamber 1<sub>3</sub> are positioned at the center line of the terminal receiving chambers 1<sub>2</sub> of the middle-column so as to form rows that are staggered in the height or Z-direction of the specially arranged housing 2.

## SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the present invention to provide a terminal inserting method in which the terminal is capable of being inserted randomly into the

desired terminal receiving chamber by carrying out by steps including pushing aside the electric wires which are inserted into the specially arranged connector housing having terminal receiving chambers which are arranged in the columns and staggered rows, by means of a guide claw.

According to one aspect of the present invention, for achieving the above-mentioned object, a method is provided for inserting a terminal into a specially arranged housing to form derived electric wires extending outwardly from the specially arranged housing where terminal receiving chambers are arranged in columns and staggered rows. A guide claw is used to push the derived electric wires aside, by the moving the guide claw entered along side of a bulkhead extending rectilinearly between columns of the terminal receiving chambers of the specially arranged housing.

The downward direction, in which the guide claw moves is capable of being harmonized with the extending direction of the rectilinear bulkhead by turning the specially arranged housing through an angle of 90° degrees.

The above and further objects and novel features of the invention will be more fully understood from the following detailed description when the same is read in connection with the accompanying drawings. It should be expressly understood, however, that the drawings are for purpose of illustration only and are not intended as a definition of the limits of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view showing one example of a method of inserting terminals into a specially arranged housing according to the present invention;

FIG. 2 is a side view showing a guide claw and a holding claw with respect to a vertical cross-section of the connector housing;

FIG. 3 is a perspective view showing a condition where the specially arranged housing is placed longitudinally;

FIG. 4 is an elevational view showing a condition where the electric wires leading from the connector housing are pushed aside by the guide claw;

FIG. 5 is a plan view showing an outline of a terminal turn-over apparatus;

FIG. 6 is a perspective view showing a terminal inserting apparatus including receiving member which holds the specially arranged housing;

FIG. 7 is a side view showing a conventional terminal inserting method;

FIG. 8 is an elevational view of FIG. 7;

FIG. 9 is a perspective view showing a condition where the specially arranged housing is placed laterally;

FIG. 10 is a side view showing the conventional problems; and

FIG. 11 is an elevational view of FIG. 10.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention will now be described in detail referring to the accompanying drawings.

FIGS. 1 to 3 show a method of inserting terminals into a specially arranged housing according to the present invention.

In this inserting method for the terminal, the specially arranged housing 2 whose terminal receiving chambers 1 are arranged in columns and staggered rows, is placed

longitudinally, so that an approach path 4, for a guide claw 3 which is used for pushing the electric wires aside, is conserved on the partition walls or bulkheads 5, 6 in the perpendicular direction thereof between the left side terminal receiving chamber 1<sub>1</sub> and the right side terminal receiving chamber 1<sub>2</sub>, or between the middle terminal receiving chamber 1<sub>2</sub> and the right side terminal receiving chamber 1<sub>3</sub>, so that the pointed end 7 of the guide claw 3 does not pass over or obstruct the opening of the terminal receiving chamber 1.

The specially arranged housing 2 is equivalent to the housing as shown in FIG. 9 of the conventional example. The specially arranged housing 2 is placed longitudinally as shown in FIG. 3. The partition wall 8 in the lateral direction thereof of the terminal receiving chamber 1<sub>2</sub> of the middle column is positioned on a line which joins the centers of the terminal receiving chambers 1<sub>1</sub>, 1<sub>3</sub> in the left side column and right side column, respectively. The bulkhead 5 lies between the left side terminal receiving chamber 1<sub>1</sub> and the middle terminal receiving chamber 1<sub>2</sub>. The bulkhead 6 lies between the right side terminal receiving chamber 1<sub>3</sub> and the middle terminal receiving chamber 1<sub>2</sub>. Since the bulkheads 5 and 6 extend rectilinearly in the vertical direction, as shown in FIG. 1, the closed guide claw 3 is capable of being moved downwardly among the derived electric wires 9 along the bulkheads 5 and 6 extending in the vertical direction. Then, as shown in FIG. 4, the derived electric wires 9 are pushed aside from left to right which is caused by the downward movement of the pair of guide claws 3a and 3b, so that the opening of the desired terminal receiving chamber 1' is not obstructed.

In the embodiment as shown in FIGS. 1 and 2, the terminal 10 is inserted horizontally into the terminal receiving chamber 1 of the guide claw 3 when the connector housing 2 is in its upright or longitudinal orientation. However, the connector housing 2, can be oriented as shown in FIG. 9 so that its right side (as shown in FIG. 3) is laying on a surface parallel to the X-direction (i.e., -90 degrees). For example, the terminal 10 may be inserted into the left side terminal receiving chamber 1<sub>1</sub>, when the connector housing has been laid on its right side and the terminal 10 may be inserted into the right side terminal receiving chamber 1<sub>3</sub> when the connector housing 2 is laid on its left side. Further, even if the connector housing is placed laterally as shown in FIG. 9, and the connector housing has an arrangement of the receiving chambers 1<sub>1</sub>, 1<sub>2</sub>, 1<sub>3</sub> which is similar to FIG. 3, it is not necessary to turn the connector housing 2 by 90 degrees. The connector housing can be used as it is shown in FIG. 9 being placed laterally.

The turning of the terminal 10 by 90 degrees is executed by using the turn-over apparatus 14 as shown in FIG. 5, prior to derived process where the electric wires 9 extending from the inserted terminals are grabbed by the grabbing claws 11, 12. The apparatus 14 is the same type as the apparatus which is proposed by the applicant in Japanese Patent Application Laid-Open No. Hei 7-142144. The turn-over apparatus 14 comprises a chuck claw 16 for receiving the derived electric wires 9 extending from the inserted terminals grabbed by the clip 15, a chuck cylinder 17 for opening and closing the chuck claw 16, a hand 18 for grabbing the derived electric wires 9 at the rear of chuck claw 16, and a positioning motor 19 for revolving the chuck claw 16 together with the cylinder 17 to the required angle. The derived electric wires 9 are twisted by the revolving of the chuck claw 16 in the grabbed condition so that the terminal 10 is turned by 90 degrees.

The grabbing claws 11 and 12 of a terminal inserting head 21 (referring to FIG. 6) can receive the twisted derived electric wires 9, extending from the derived terminal, from the inserted chuck claw 16. As shown in FIG. 2, the pointed end of the terminal has been inserted into the connector housing 2 through the guide claw 3 during the grabbing of the derived electric wires 9 by the grabbing claws 11 and 12 on both sides, before the entire terminal 10 is inserted by only the rear side grabbing claw 12.

FIG. 6 shows an automatic terminal inserting apparatus as one example of a holding method for the connector housing 2. The connector housing 2 is pressed to be held to an L-shaped connector receiving member 22 in the longitudinally placed condition by a spring piece 23. The receiving member 22 is removed from the base member 25, on the palter 24 by the chuck section 26 which can shift freely in the three-dimensional direction. In this condition, the terminal 10 is inserted into the connector housing 2 on the receiving member 22 by the terminal inserting head 21. The apparatus 27 has been proposed in the Japanese Patent Application No. Hei 7-203344.

As stated above, according to the present invention, since the pointed end of the guide claw, for pushing aside the electric wires, is capable of being moved downwardly among the electric wires and along the bulkhead extending rectilinearly between the terminal receiving chambers of the connector housing, the pointed end of the guide claw does not impinge on the electric wires so that the electric wires are not damaged. For this reasons, even with the specially arranged housing in which the terminal receiving chambers are arranged in columns and staggered rows, the electric wires are capable of being pushed aside, so that the terminals can be inserted randomly into the desired terminal receiving chamber. Consequently, even when the specially arranged housing is used, the terminal insertion is capable of being automated.

While preferred embodiments of the invention have been described using specific terms, such description is for illustrative purpose only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A method of inserting terminals into a specially arranged housing, said method comprising the steps of:
  - a) providing a specially arranged housing having terminal receiving chambers into which said terminals are to be inserted, wherein said terminal receiving chambers of said specially arranged housing are arranged in columns and in staggered rows such that a longitudinal axis of adjacent rows are at different elevations in order to allow electric wires connected to an end of said terminals and extending outwardly from said terminal receiving chambers of said specially arranged housing to be pushed aside by means of a guide claw so as to prevent interference with an insertion of subsequent electric wires;
  - b) guiding one of said terminals and an associated electric wire held in said guide claw along a bulkhead extending rectilinearly between columns of said terminal receiving chambers of said specially arranged housing; and inserting said terminals into said terminal receiving chambers of said specially arranged housing.
2. The method of inserting terminals into a specially arranged housing according to claim 1, wherein a direction of guiding said guide claw is in accordance with an extending direction of said bulkhead by setting said bulkhead



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vertically by turning said specially arranged housing by an angle of 90 degrees.

3. The method of inserting terminals into a specially arranged housing according to claim 2, wherein a pointed end of a terminal is inserted in a first step into said terminal receiving chamber through a hole on said guide claw and an entire terminal is inserted into said terminal receiving chamber in a secondary step.

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4. The method of inserting terminals into a specially arranged housing according to claim 1, wherein a pointed end of a terminal is inserted in a first step into said terminal receiving chamber through a hole on said guide claw and an entire terminal is inserted into said terminal receiving chamber in a secondary step.

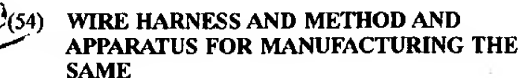
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(12) **Patent Application Publication**  
**Miyamoto et al.**

(10) Pub. No.: ~~US 2001/0001345 A1~~

(43) Pub. Date: May 24, 2001



**(30) Foreign Application Priority Data**

Aug. 27, 1997 (JP)..... P. HEI. 9-230711

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### Publication Classification

(51) **Int. Cl.<sup>7</sup>** ..... **B23P 19/00; H01R 43/00**

(52) U.S. Cl. .... 29/749; 29/755

(57) **ABSTRACT**

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(21) Appl. No.: 09/761,689

(22) Filed: Jan. 18, 2001

### Related U.S. Application Data

(62) Division of application No: 09/140,669, filed on Aug. 26, 1998.

A wire harness is made up of a plurality of partial harnesses. Each of the partial harnesses is arranged such that opposite end portions of a plurality of electric wires having terminals at ends thereof are retained in advance in U-shapes with predetermined intervals provided so as to correspond to a plurality of connectors into which the terminals are inserted, by a plurality of wire clamps juxtaposed at equal pitches on a wire clamping bar. The terminals at the ends of the plurality of electric wires in each of the partial harnesses are inserted into terminal accommodating chambers of predetermined connectors selected from the plurality of connectors, thereby aggregating the partial harnesses into a combined unit.

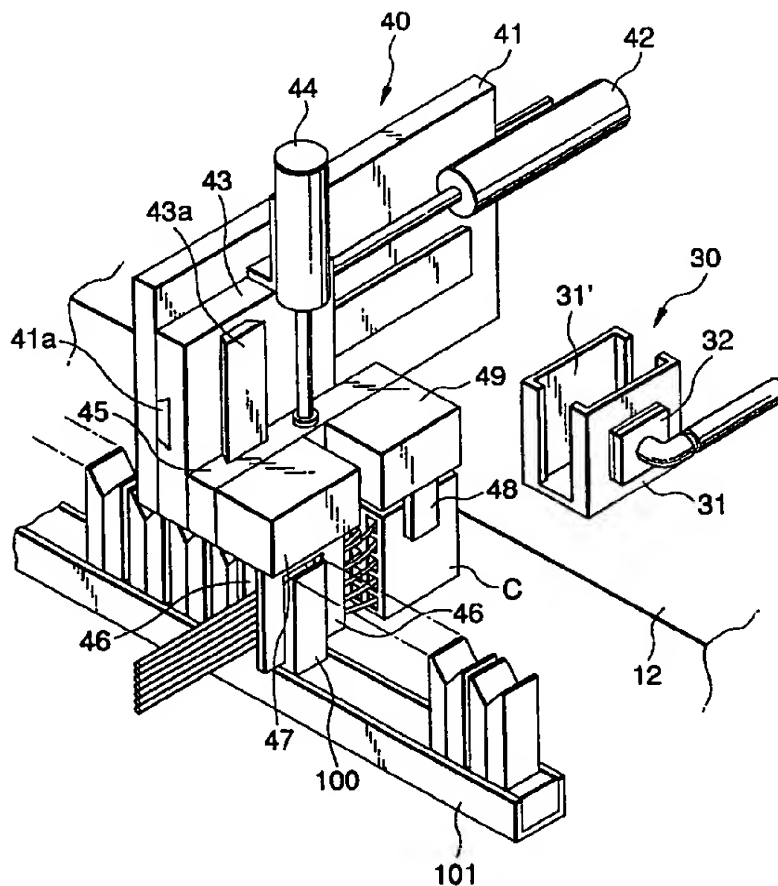


FIG.1

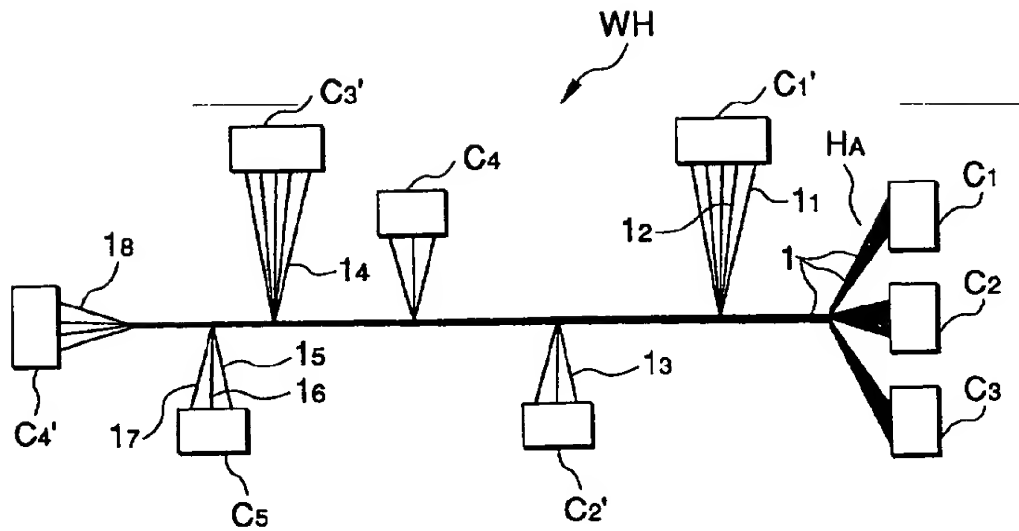


FIG.2A

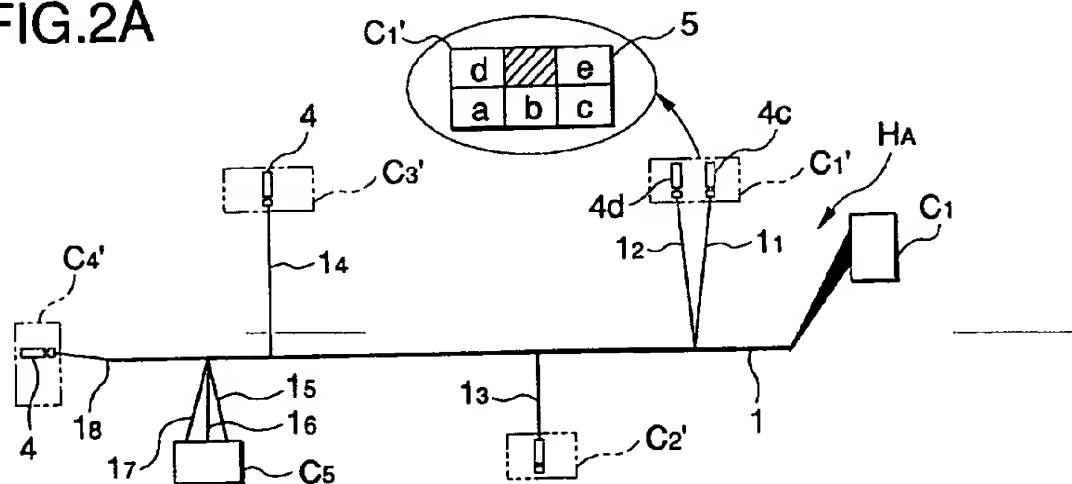


FIG.2B

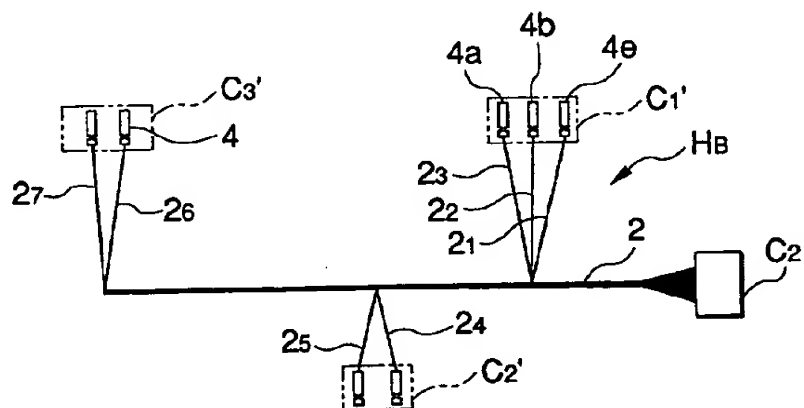


FIG.2C

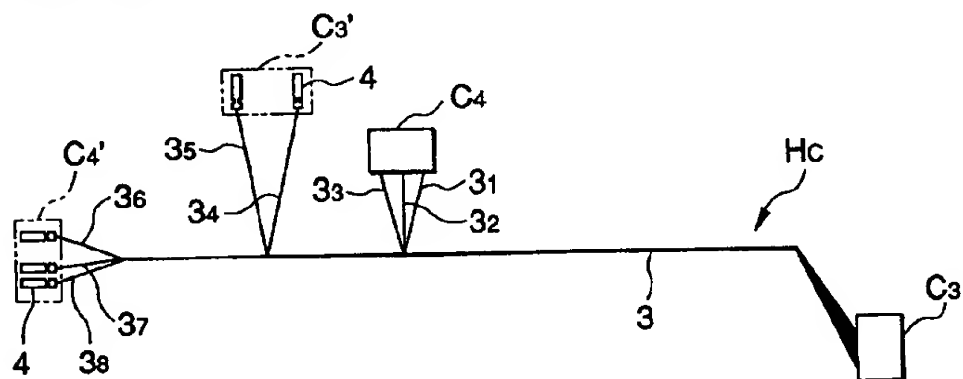


FIG.3A

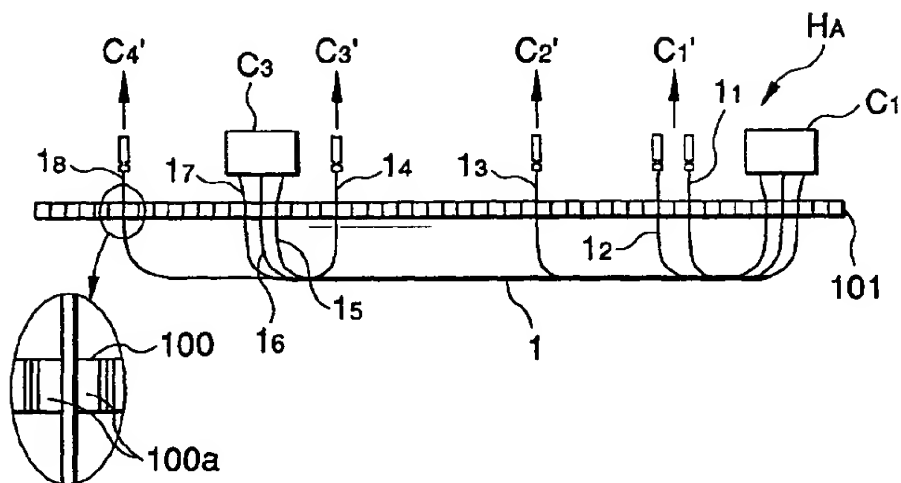


FIG.3B

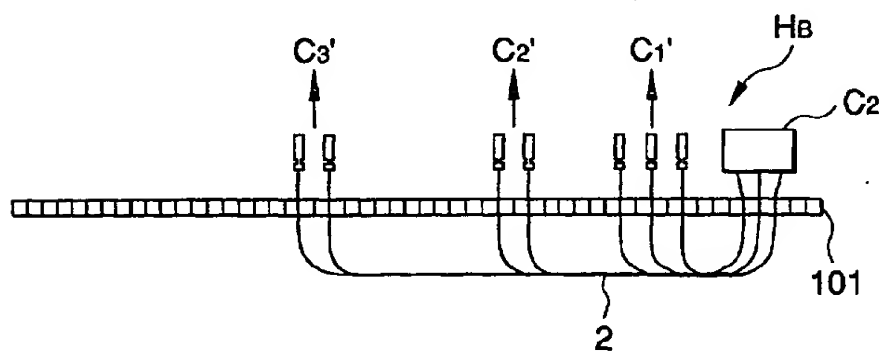
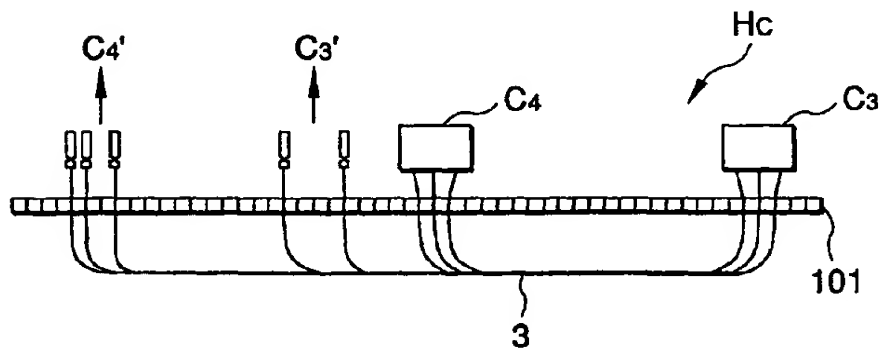


FIG.3C



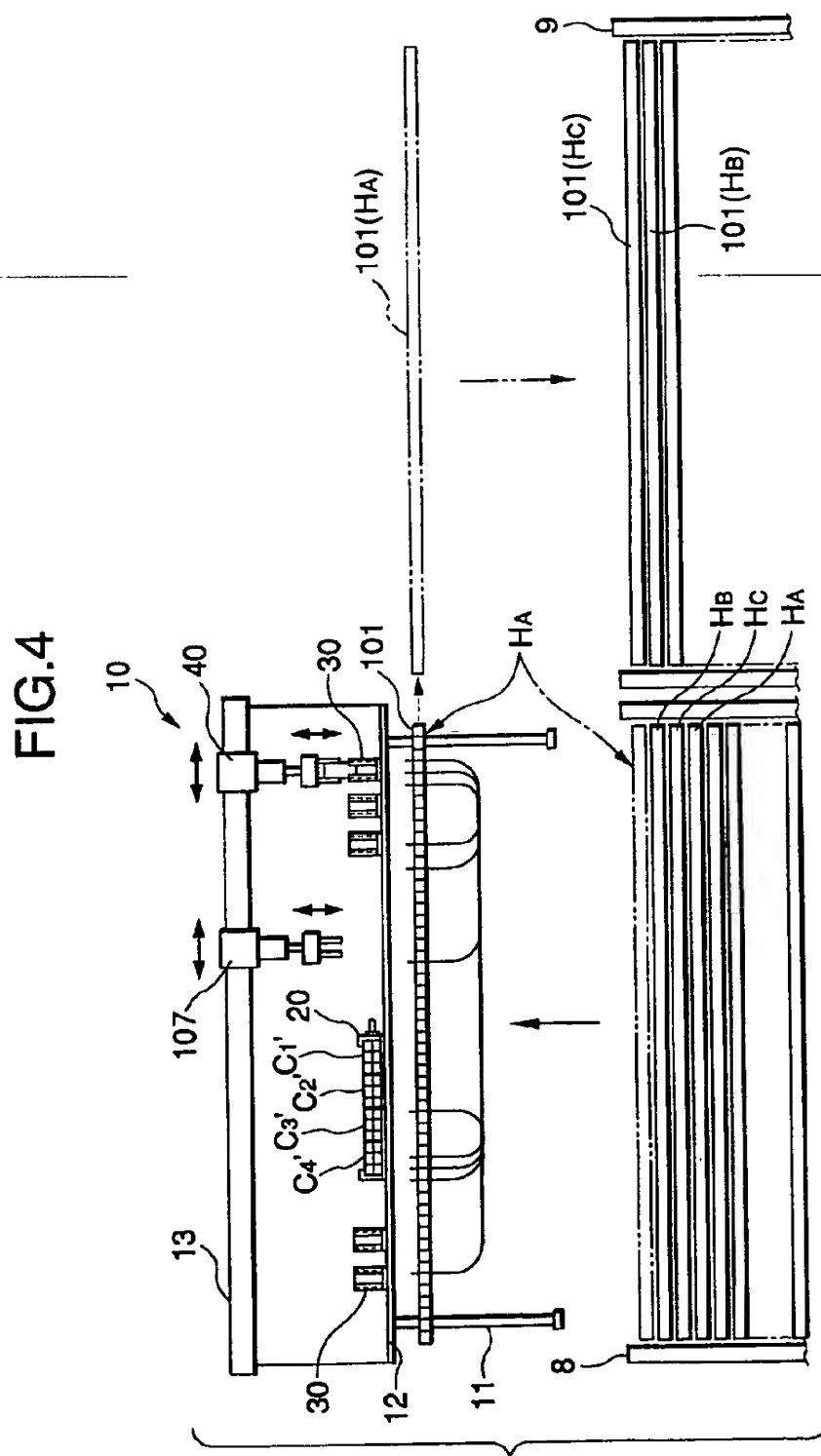


FIG.5

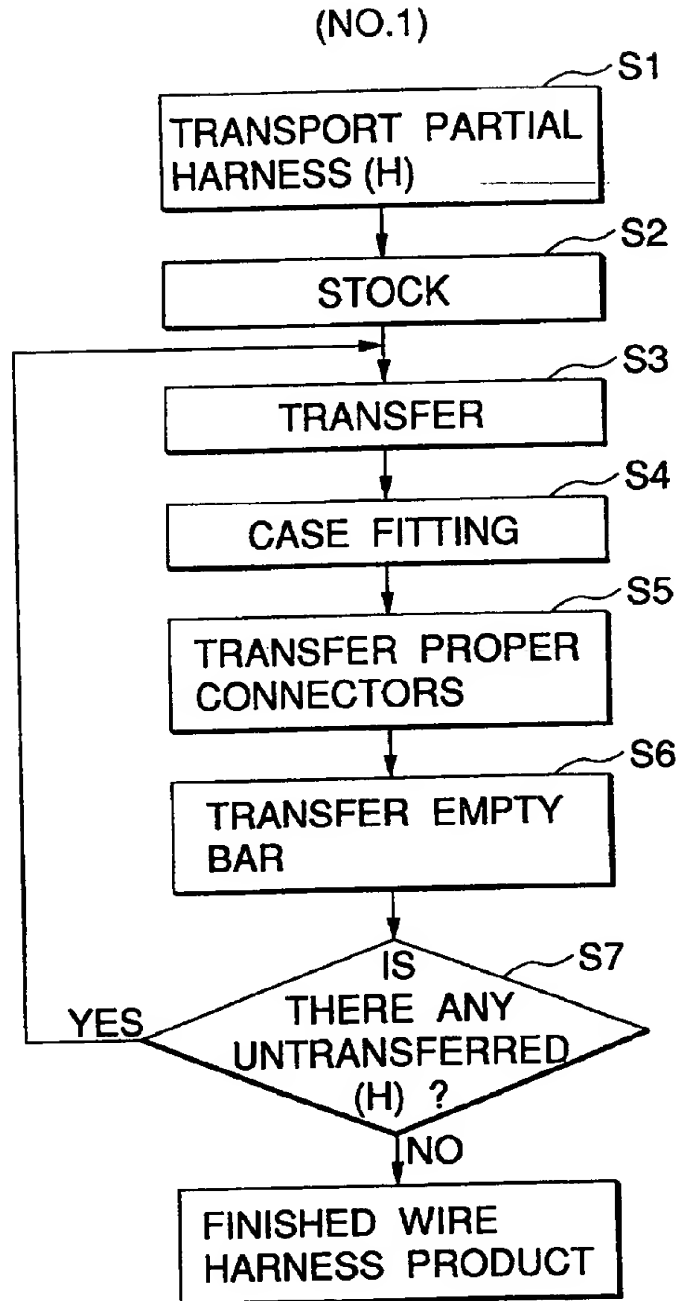


FIG.6

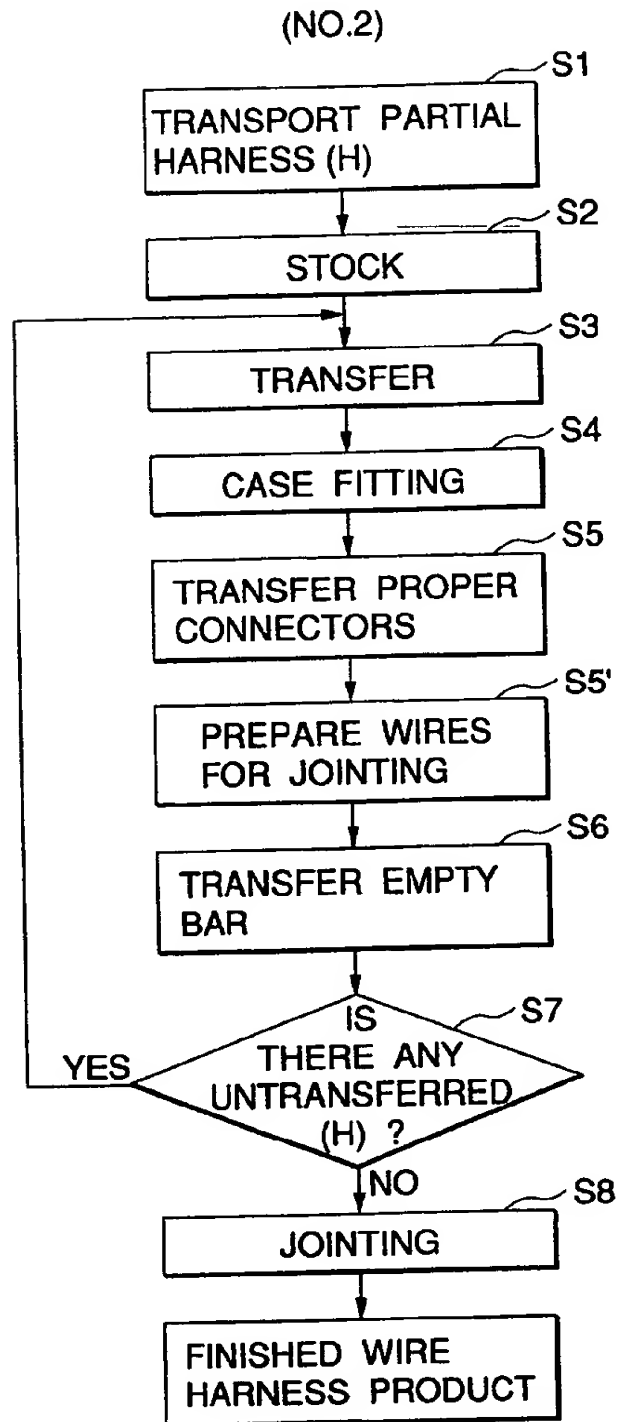




FIG.7A

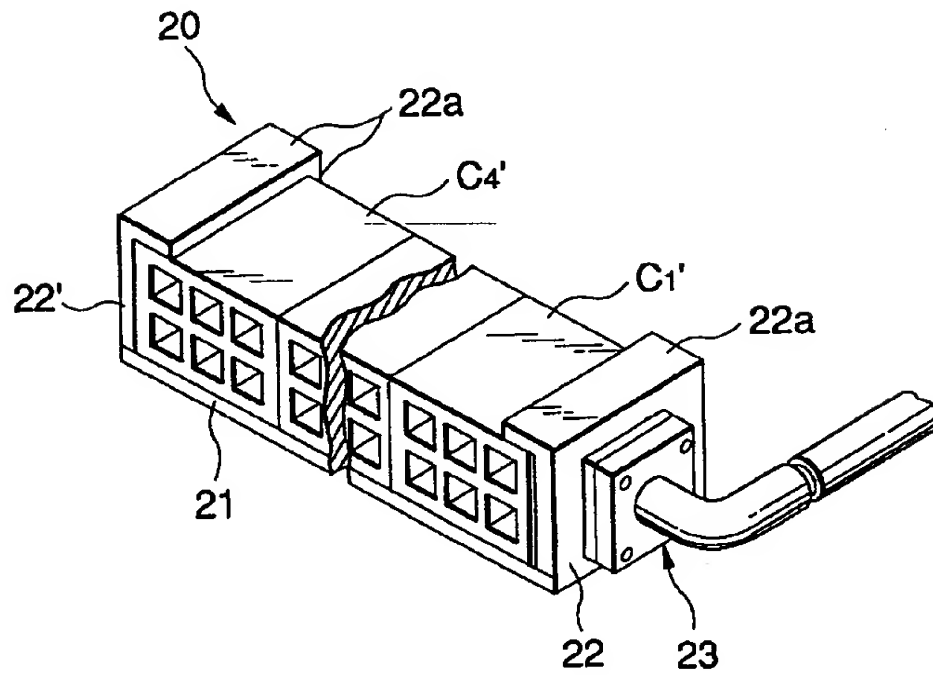


FIG.7B

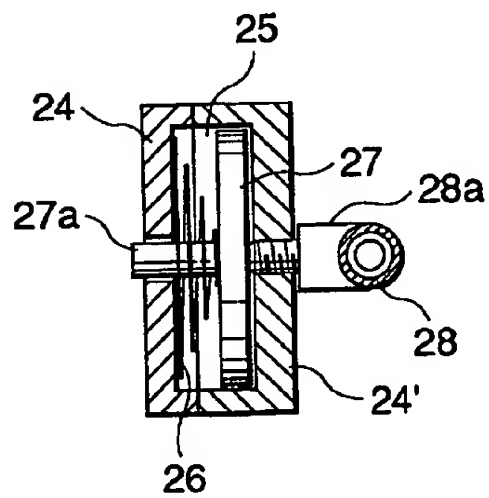


FIG. 8

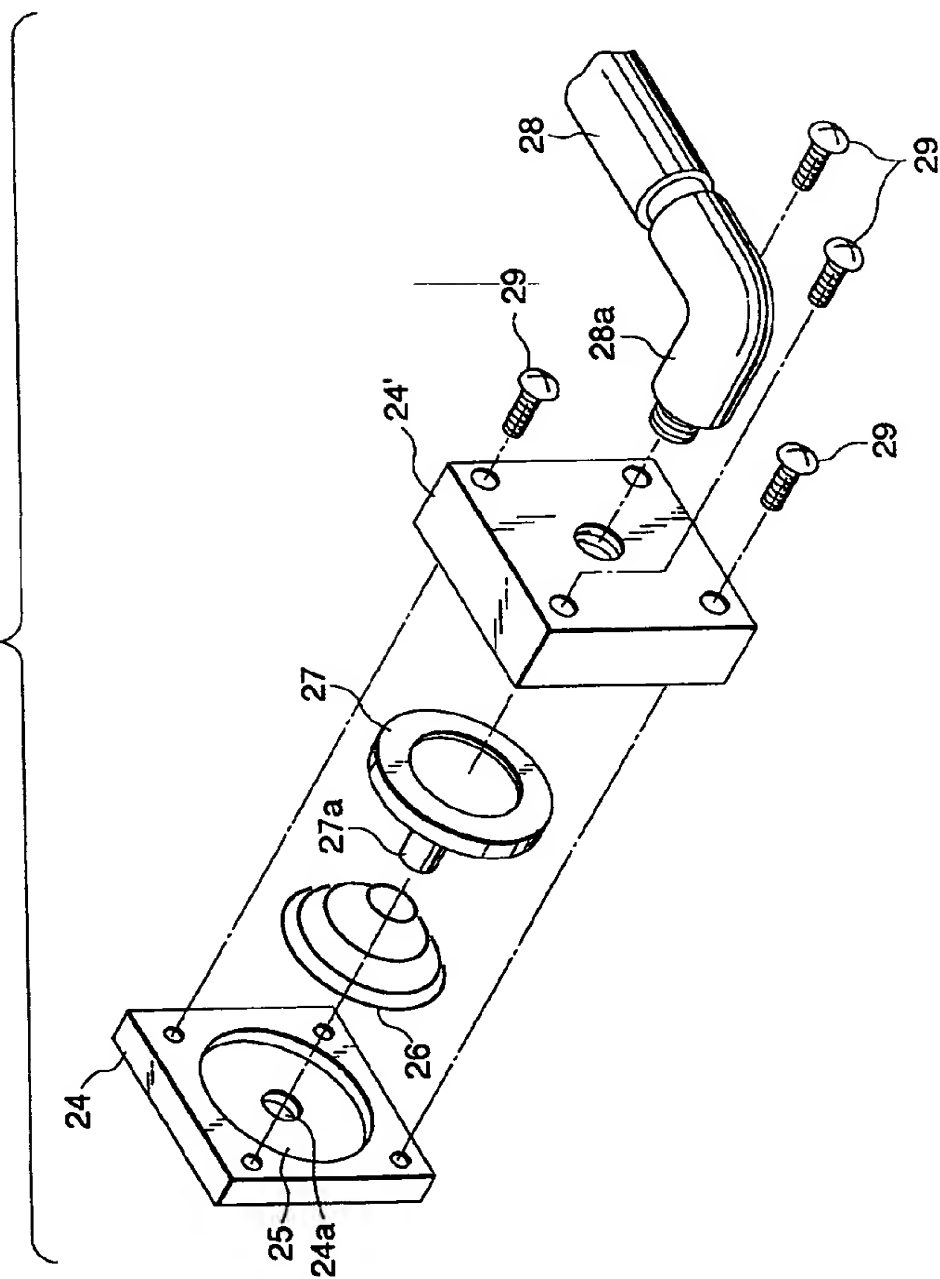


FIG.9

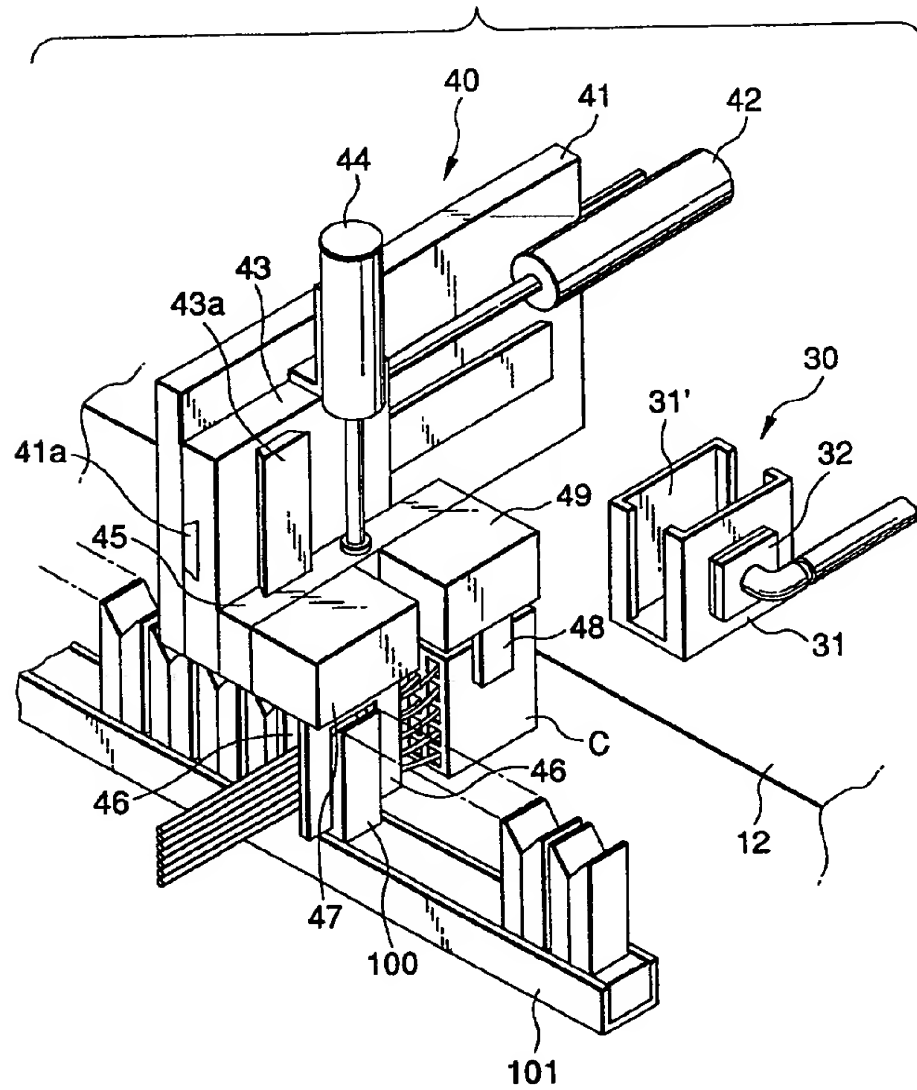


FIG.10A

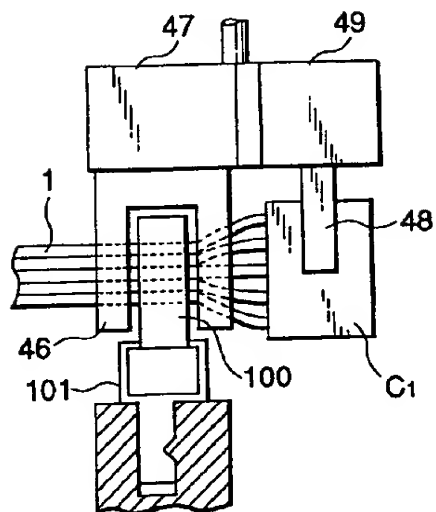


FIG.10B

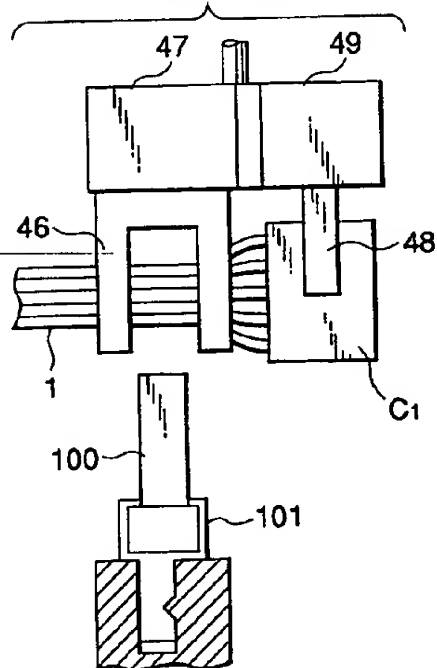


FIG.10C

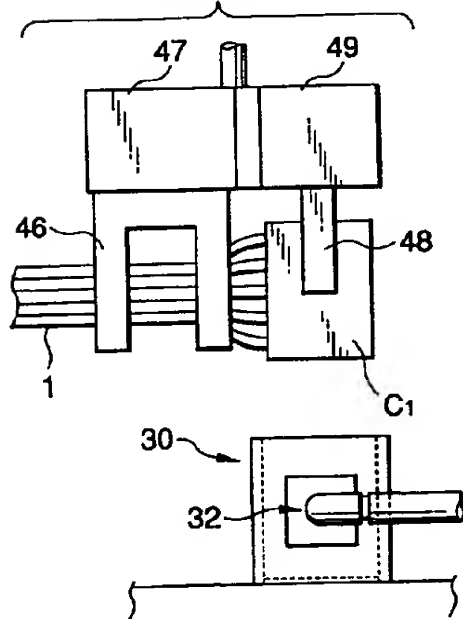
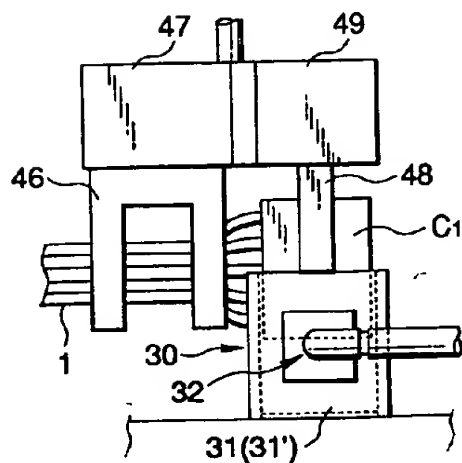


FIG.10D





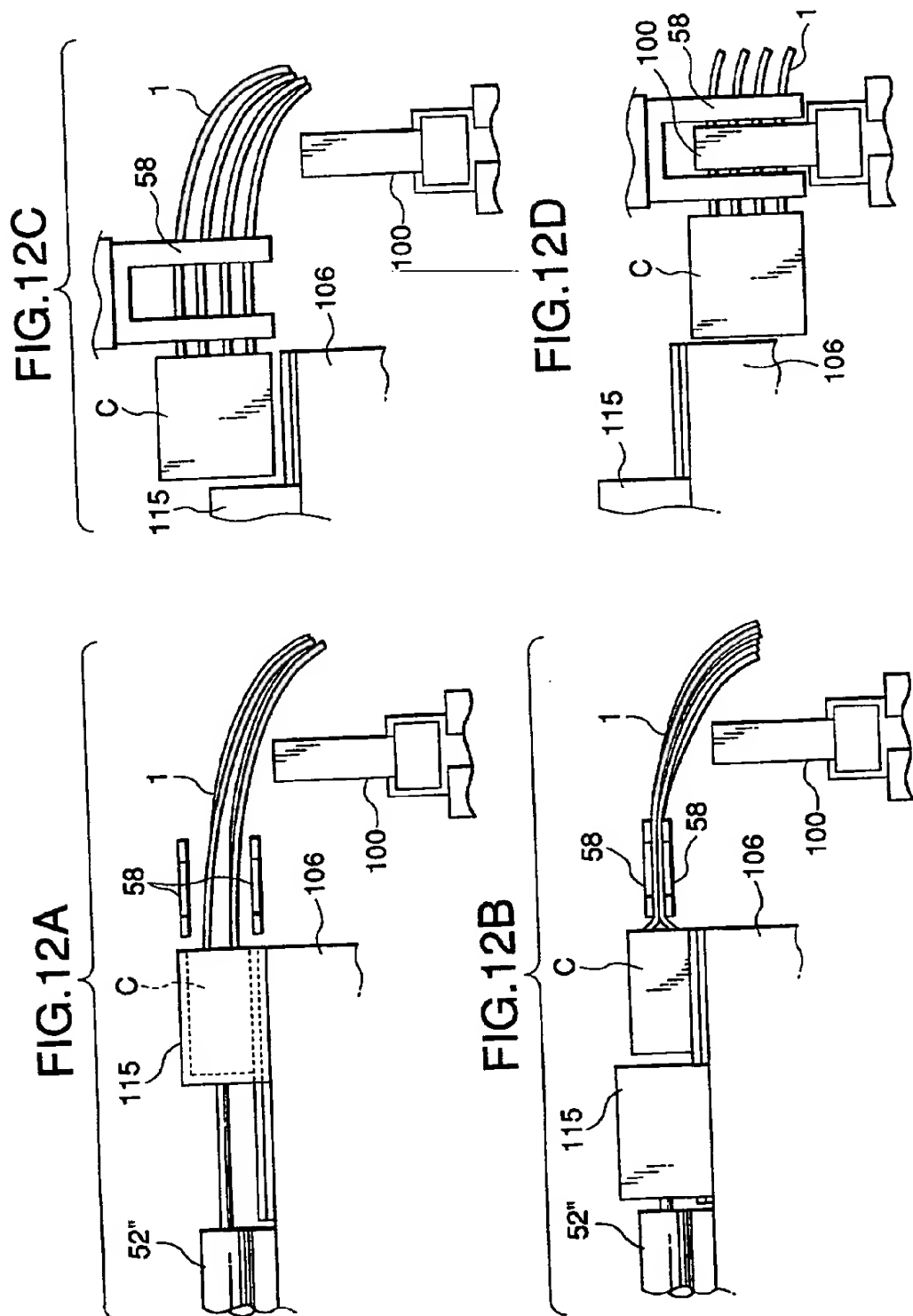


FIG.13  
PRIOR ART

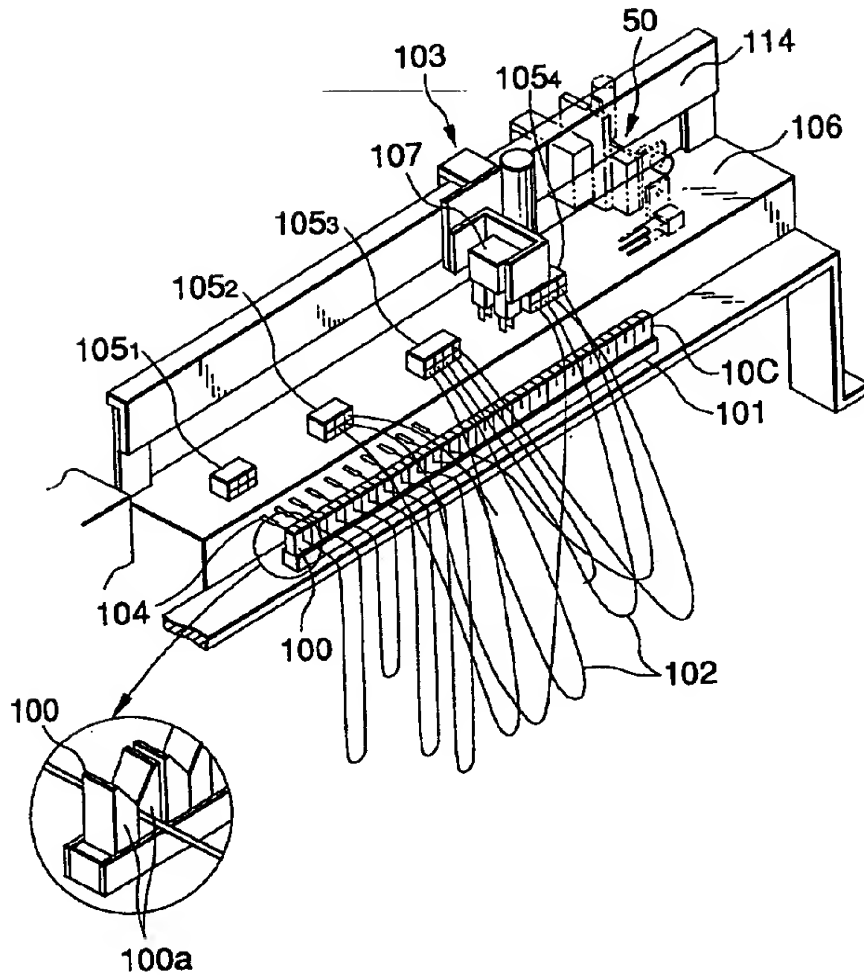
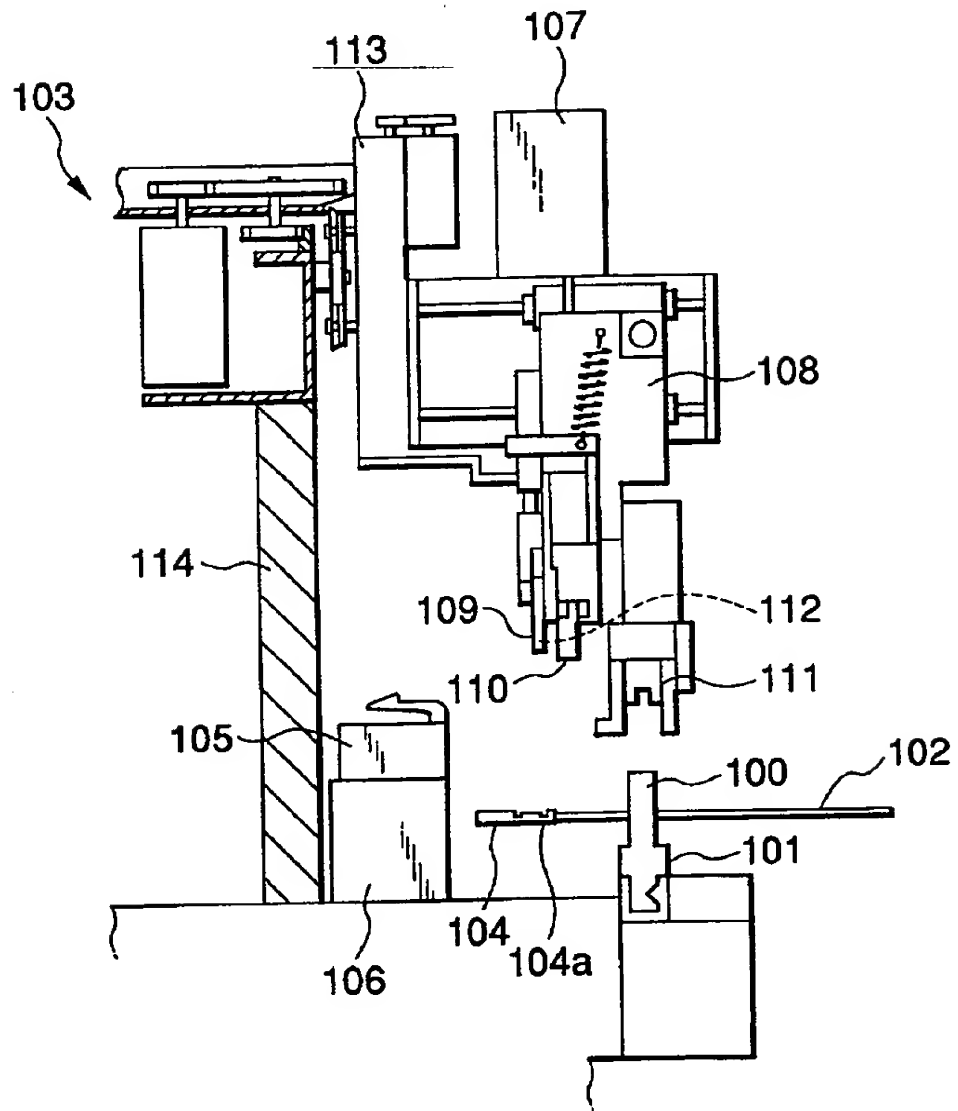


FIG.14  
PRIOR ART





# WIRE HARNESS AND METHOD AND APPARATUS FOR MANUFACTURING THE SAME

## BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to a wire harness and a method and an apparatus for manufacturing the same, and more particularly to the manufacture of one wire harness (or one sub-harness) by combining a plurality of partial harnesses.

[0003] The present application is based on Japanese Patent Application No. Hei. 9-230711, which is incorporated herein by reference.

[0004] 2. Description of the Related Art

[0005] As is known, there are a plurality of wire harnesses used in the electrical wiring of an automobile, including such as an engine harness, an instrument panel harness, a cowl side harness, a door harness, and a roof harness.

[0006] As a method and an apparatus for manufacturing such wire harnesses, as shown in FIG. 13, a method and an apparatus are known which use a wire clamping bar 101 in which a multiplicity of wire clamps 100 are juxtaposed at equal pitches. Incidentally, each wire clamp 100 comprises a pair of mutually opposing clamp members 100a, and electric wires are clamped therebetween.

[0007] After a plurality of electric wires 102 for forming one wire harness are cut to a predetermined length, opposite end portions thereof are retained by mutual adjacent wire clamps 100 and are held in U-shapes on the wire clamping bar 101. In this state, end processing such as stripping (removal of an insulating sheath) of a wire end and crimping of a terminal is performed.

[0008] This wire clamping bar 101 is set in or transferred to a case fitting station 103, and terminals 104 at wire ends are respectively inserted and fitted into terminal accommodating chambers (not shown) of a connector housing (hereafter, simply referred to as the connector) 105 by using an automatic terminal inserting device 107.

[0009] A plurality of connectors 105 are arranged in advance on a setting table 106 as shown at reference numerals 105<sub>1</sub> to 105<sub>4</sub>. The terminals 104 are inserted into and retained in predetermined terminal accommodating chambers of connectors selected from the plurality of connectors 105<sub>1</sub> to 105<sub>4</sub> in a predetermined order.

[0010] As shown in FIG. 14, the automatic terminal inserting device 107 has a mounting head 108, a pair of terminal gripping claws 109 for a wire connecting portion 104a of the terminal 104 and a pair of wire gripping claws 110 are provided at a lower end of the mounting head 108 in such a manner as to be capable of being raised or lowered and of being opened or closed. Further, a pair of wire clamp plates 111 which can be opened or closed is provided at the lower end of the mounting head 108, and a terminal holding plate 112 is provided between the pair of terminal gripping claws 109 in such a manner as to be capable of being raised or lowered.

[0011] Further, the mounting head 108 is provided in such a manner as to be capable of moving close to or away from the wire clamp 100 (or the wire clamping bar 101) and of

being raised or lowered with respect to the same. Further, a moving plate 113 for supporting the mounting head 108 is mounted on a supporting frame 114 of the case fitting station 103, and is provided in such a manner as to be horizontally movable with respect to the setting table 106 on which the plurality of connectors 105 are arranged.

[0012] Accordingly, according to the automatic terminal inserting device 107, the terminal 104 can be automatically inserted into the connector 105 by repeating the following steps a to d.

[0013] a. The mounting head is moved to immediately above desired wire clamp 100 of the wire clamping bar 101 by means of the moving plate 113.

[0014] b. At the same time as the lowering and raising operation of the mounting head 108, an end portion of the wire 102 including the terminal 104 is gripped by the opening/closing operation of the terminal gripping claws 109, the wire gripping claws 110, and the wire clamp plates 111, and is lifted up from the wire clamp 100 which retained the wire.

[0015] c. Then, the mounting head 108 is moved in parallel to the wire clamping bar 101, and is stopped at a position opposing a desired terminal accommodating chamber of the desired connector 105.

[0016] d. The mounting head 108 is advanced forward toward the connector 105, and while the terminal 104 is being inserted into the terminal accommodating chamber, the terminal gripping claws 109, the wire gripping claws 110, and the wire clamp plates 111 are opened consecutively beginning at the front side, thereby releasing the wire end portion. Namely, the terminal 104 is automatically inserted and fitted into the predetermined terminal accommodating chamber of the predetermined connector.

[0017] Thus, there is an advantage, among others, in that, by using the wire clamping bar 101 in which the multiplicity of wire clamps 100 are juxtaposed, all the end processing of wires, including the cutting, retention, stripping, terminal crimping, and case fitting (insertion and fitting of a terminal into a connector) of a multiplicity of wires which make up one wire harness, can be handled on one side of the wire clamping bar. A method and an apparatus similar to the above-described method and apparatus have been disclosed in Japanese Patent Publication No. Hei. 5-55994.

[0018] However, since the engine harness, for example, is made up by numerous wires which generally comprise as many as 200 circuits (the number of wires: 200, the number of both end portions that are retained in U-shapes: 400), the number of connectors that are fitted to the wire ends is also numerous. As such, if end processing is performed with respect to these wires by using a single wire clamping bar, troubles are liable to occur, such as erroneous wiring of wires, erroneous crimping of a terminal, erroneous insertion into a connector, and entanglement of wires or terminals.

[0019] On the other hand, to handle numerous wires by a single wire clamping bar, an extremely long bar is required, and not only is a wide working space required, but also a pitch time from the cutting of the wire until completion of final case fitting becomes very long. Hence, the apparatus becomes large and automatic control becomes complex and expensive. Furthermore, if there occurs erroneous wiring or

erroneous insertion or the like, since it takes time and trouble in correcting them in an ensuing process, wastage can occur such as discarding the entire wires on the wire clamping bar as defective products.

#### SUMMARY OF THE INVENTION

[0020] An object of the present invention is to eliminate the above-mentioned drawbacks. More specifically, an object of the present invention is to provide a wire harness which can be fabricated in a relatively narrow space in a short time, and in which erroneous wiring of wires, erroneous crimping or insertion of terminals, and entanglement of wires are unlikely to occur, as well as a method and an apparatus for manufacturing the same. In addition, another object of the present invention is to provide a wire harness and a method for manufacturing the same which are suitable for production of a large variety of products in small lots.

[0021] In order to achieve the above objects, the present inventors first analyzed various forms of wire harness which are used in a single automobile.

[0022] Namely, as shown in FIG. 1, one wire harness WH is provided with a plurality of connectors  $C_1$  to  $C_5$  and connectors  $C_1'$  to  $C_4'$  in correspondence with its installation routes. The connectors  $C_1$  to  $C_5$  are connectors which are proper to a relevant partial harness and in which only terminals of wires making up the partial harness are inserted and fitted, as will be described later. The connectors  $C_1'$  to  $C_4'$  are hybrid connectors into which terminals of different partial harnesses are respectively inserted and fitted in mixed form.

[0023] For example, among a plurality of wires 1 making up a partial harness  $H_A$  to one end of which the proper connector  $C_1$  is fitted, three wires  $1_5$  to  $1_7$  are fitted to the proper connector  $C_5$ . However, other wires  $1_1$  and  $1_2$  are connected to the hybrid connector  $C_1'$ , a wire  $1_3$  is connected to the hybrid connector  $C_2'$ , a wire  $1_4$  is connected to the hybrid connector  $C_3'$ , and a wire  $1_8$  is connected to the hybrid connector  $C_4'$ .

[0024] Thus, although one connector (the proper connector  $C_1$ ) is fitted to one ends of a plurality of wires, terminals at other ends of these wires are not necessarily inserted and fitted into only one connector (the proper connector  $C_5$ ), but are inserted and fitted into other connectors (hybrid connectors  $C_1'$  to  $C_4'$ ) in a distributed manner, so that troubles such as erroneous wiring of wires and erroneous insertion of terminals are liable to occur.

[0025] Accordingly, by taking note of the fact that one wire harness (or one sub-harness) is divided into a number of partial harnesses in which terminals of one ends of a group of wires are inserted and fitted into a specific connector (e.g., one of the proper connectors  $C_1$  to  $C_5$ ), while terminals at the other ends thereof are inserted and fitted into two or more connectors (e.g., the hybrid connectors  $C_1'$  to  $C_4'$ ) in a distributed manner, the present inventors found out that numerous troubles associated with the conventional technique can be overcome by combining these partial harnesses into one unit.

[0026] Namely, according to the first aspect of the present invention, there is provided a wire harness comprising a plurality of partial harnesses, wherein each of the partial harnesses is arranged such that opposite end portions of a

plurality of electric wires having terminals at ends thereof are retained in advance in U-shapes with predetermined intervals provided so as to correspond to a plurality of connectors into which the terminals are inserted, by a plurality of wire clamps juxtaposed at equal pitches on a wire clamping bar, and wherein the terminals at the ends of the plurality of electric wires in each of the partial harnesses are inserted into terminal accommodating chambers of predetermined connectors selected from the plurality of connectors, thereby aggregating the plurality of partial harnesses into a combined unit. In accordance with the above-described first aspect of the present invention, if a wire harness formed by, for example, about 200 wires is divided into four parts, the wire harness can be formed as partial harnesses each comprising about 50 wires, the partial harnesses can be fabricated in a relatively narrow space by using a short wire clamping bar, and end processing can be performed in a short time. In a case where, for example, two partial harnesses each comprising 50 wires are aggregated as one sub-harness comprising 100 wires, and two sub-harnesses are combined into one wire harness comprising 200 wires, the sub-harness, which is a semifinished product, is also included in the wire harness referred to in the present invention. In addition, each individual partial harness has a small number of wires, erroneous wiring and erroneous insertion of the terminal are unlikely to occur, such troubles can be easily detected, correction thereof is easy, and it is possible to speedily cope with circuit changes such as optional circuits. Furthermore, since the number of wires is small, entanglement of wires and terminals during case fitting is reduced, and smooth end processing can be effected.

[0027] According to the second aspect of the present invention, in the wire harness according to the first aspect of the present invention, the plurality of connectors into which the terminals are inserted comprise at least one of connectors proper to a relevant partial harness into which only the terminals of the plurality of electric wires making up each of the partial harnesses are inserted and hybrid connectors into which the terminals of the electric wires of two or more of the partial harnesses are inserted in mixed form. Since the plurality of connectors which are fitted to one wire harness are clearly classified into connectors proper to the partial harness alone and hybrid connectors into which the electric wires of a plurality of partial harnesses are fitted in mixed form, end processing of wires is further systematized and simplified, and programming for automation is facilitated.

[0028] According to the third aspect of the present invention, in the wire harness according to the first aspect of the present invention, the proper connector is fitted in advance to the ends of predetermined ones of the electric wires of each of the partial harnesses. As a result, in a final process in which the partial harnesses are aggregated into one wire harness, it suffices if the terminals are consecutively inserted into only the hybrid connectors, thereby simplifying the process of end processing.

[0029] According to the fourth aspect of the present invention, in the wire harness according to the first aspect of the present invention, the hybrid connector is fitted in advance to the ends of the electric wires of one or two of the partial harnesses selected from the plurality of partial harnesses. In accordance with the fourth aspect of the present invention, if, for example, all the estimated hybrid connectors are fitted

in advance to one partial harness, the wires of the other partial harnesses are not mixed in that partial harness, so that there is no possibility of the occurrence of erroneous wiring. Accordingly, whether the hybrid connectors are to be fitted in advance to the partial harness can be selected as required.

[0030] According to the fifth aspect of the present invention, in the wire harness according to the first aspect of the present invention, each of the partial harnesses includes electric wires to stripped ends of which terminals are unconnected, and the stripped ends thereof are jointed in the aggregated state. In a wire harness, so-called joint portions are often present which are formed such that an intermediate portion of a wire is stripped due to the circuit configuration, and an end of another wire is connected thereto, or stripped end portions of two or more wires are connected together by using or without using a joint terminal. In such a case, by jointing the wire ends or the intermediate portion in the final process of aggregating into one wire harness, end processing is facilitated, and the occurrence of erroneous wiring can be prevented. It should be noted that so-called double crimping and triple crimping in which stripped ends of two or more wires are connected to one terminal by crimping or another method can be included in joint processing.

[0031] Furthermore, according to the sixth aspect of the present invention, there is provided a method of manufacturing a wire harness from the plurality of partial harnesses according to any one of the first to fifth aspects of the present invention, comprising steps of: a) transferring the wire clamping bar which holds an initial one of the partial harnesses to a wire-harness fabricating station; b) inserting the terminals at the ends of the plurality of electric wires consecutively into predetermined terminal accommodating chambers of predetermined ones of the connectors selected from the plurality of connectors set on a connector receiving jig in the wire-harness fabricating station; c) removing the wire clamping bar which has been emptied; and d) repeating the above steps a) to c) consecutively for ensuing ones of the partial harnesses. Each of the partial harnesses can be fabricated in accordance with a known manufacturing method and by using a known method (e.g., Japanese Patent Publication No. Hei. 5-55994). Accordingly, in accordance with the sixth aspect of the present invention, it suffices if the wire clamping bar for an initial partial harness is transferred to a wire-harness fabricating station (step a)), and if the uninserted terminals of the relevant partial harness are inserted into predetermined terminal accommodating chambers of predetermined connectors in the wire-harness fabricating station (step b)). This step b) can be executed by using the automatic terminal inserting device 107 shown in FIG. 13. Then, if the wire clamping bar which has been emptied of the wires for which insertion of the terminals has been completed is removed, and is transferred to, for instance, an empty-bar placing rack, the processing of one partial harness ends. Thus, by the mere addition of steps a), c), and d), it is possible to easily manufacture the wire harness by using the known method and apparatus.

[0032] According to the seventh aspect of the present invention, the method of manufacturing a wire harness according to the sixth aspect of the present invention further comprises a step of transferring the proper connector fitted in advance to the ends of predetermined ones of the electric wires of each of the partial harnesses to the connector receiving jig in the wire-harness fabricating station. Namely,

in a case where a proper connector has been fitted to the partial harness, it suffices if the step of transferring the proper connector to the connector receiving jig in the wire-harness fabricating station is merely added. Consequently, steps a) and b) can be effected smoothly with respect to ensuing partial harnesses as well.

[0033] According to the eighth aspect of the present invention, the method of manufacturing a wire harness according to the sixth or seventh aspect of the present invention further comprises a step of collectively jointing, in the wire-harness fabricating station, two or more stripped portions of the electric wires included in each of the partial harnesses. Since the joint processing of the wires is collectively effected in the wire-harness fabricating station, the process is simplified, and erroneous wiring and erroneous connection can be eliminated.

[0034] According to the ninth aspect of the present invention, the method of manufacturing a wire harness according to the sixth or seventh aspect of the present invention further comprises a step of jointing, in the wire-harness fabricating station, stripped portions of the ends of the electric wires included in each of the partial harnesses, such that the stripped portions are consecutively superposed one on top of another each time each of the partial harnesses is transferred to the wire-harness fabricating station. Since stripped ends of the wires are jointed and integrated in the end processing of each of the partial harnesses, extra operation for correcting the deformation of the exposed stripped portions due to contact with other wires can be eliminated.

[0035] According to the tenth aspect of the present invention, there is provided an apparatus for implementing the method of manufacturing a wire harness according to any one of the sixth to ninth aspects of the present invention, comprising: a wire-harness fabricating station for forming a single wire harness from the partial harnesses, the wire-harness fabricating station having a connector receiving jig for detachably holding the plurality of proper connectors and the plurality of hybrid connectors. Consequently, the method according to the sixth aspect of the present invention, particularly steps a) and b) can be executed reliably.

[0036] According to the eleventh aspect of the present invention, in the apparatus for manufacturing a wire harness according to the tenth aspect of the present invention, the wire-harness fabricating station is preferably provided with a connector transferring device for transferring, to the connector receiving jig, the proper connectors and/or hybrid connectors which are fitted in advance to the partial harness. In this case, full automation of the manufacturing method according to the sixth aspect of the present invention including step b) becomes possible.

[0037] As described above, in the present invention, one wire harness (or one sub-harness) is formed by a number of partial harnesses in which terminals of one ends of a group of wires are inserted into one connector, and terminals at the other ends thereof are inserted into other connectors in a distributed manner. Therefore, it is possible to provide a wire harness which can be fabricated in a relatively narrow space in a short time, in which erroneous wiring of wires, erroneous crimping or insertion of terminals, and entanglement of wires are unlikely to occur, and which is suitable for production of a large variety of products in small lots, as well as a method and an apparatus for manufacturing the same.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. 1 is a diagram illustrating a general form of a wire harness, which is used for explaining the present invention;

[0039] FIGS. 2A to 2C are diagrams respectively illustrating partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$  making up the wire harness in accordance with an embodiment of the present invention;

[0040] FIGS. 3A to 3C are diagrams illustrating states in which the partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$  corresponding to FIGS. 2A, 2B, and 2C are respectively retained by wire clamping bars;

[0041] FIG. 4 is a schematic diagram illustrating an embodiment of a device for forming the partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$  shown in FIGS. 2A to 2C and 3A to 3C into one wire harness;

[0042] FIG. 5 is a flowchart on manufacturing steps illustrating an embodiment of a method of manufacturing a wire harness in accordance with the present invention;

[0043] FIG. 6 is a flowchart on manufacturing steps illustrating another embodiment of the method of manufacturing a wire harness in accordance with the present invention;

[0044] FIG. 7A is a perspective view of a connector receiving jig for hybrid connectors  $C'$  in accordance with the present invention;

[0045] FIG. 7B is a cross-sectional view of an air cylinder unit 23 of the connector receiving jig;

[0046] FIG. 8 is an exploded perspective view of the air cylinder unit 23;

[0047] FIG. 9 is a perspective view of a connector transferring device 40 for transferring the connector, into which terminals have been inserted and fitted, from the wire clamping bar to a wire-harness fabricating station;

[0048] FIGS. 10A to 10D are diagrams respectively illustrating the operation of the connector transferring device 40 shown in FIG. 9;

[0049] FIG. 11 is a perspective view of a second connector transferring device for retaining at the wire clamping bar the connector into which terminals have been inserted and fitted;

[0050] FIGS. 12A to 12D are diagrams respectively illustrating the operation of the second connector transferring device shown in FIG. 11;

[0051] FIG. 13 is a diagram illustrating a conventional wire-harness manufacturing apparatus; and

[0052] FIG. 14 is a diagram illustrating a conventional terminal inserting device.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0053] Referring now to the accompanying drawings, a detailed description will be given of an embodiment of the present invention.

[0054] FIGS. 2A to 2C respectively show states in which three partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$  which make up a

wire harness WH shown in FIG. 1 are developed two-dimensionally in correspondence with actual forms of routing. In the drawings, a thick line indicates a plurality of electric wires, and a thin line indicates a single electric wire.

[0055] All terminals (not shown) at one end of a group of electric wires 1 which make up the partial harness  $H_A$  are inserted and fitted in a proper connector  $C_1$ . The other end of the group of electric wires 1 extends along the arrangement of predetermined hybrid connectors  $C_1'$ - $C_4'$  and a proper connector  $C_5$  of the wire harness WH. The proper connector  $C_5$  is fitted to the ends of three wires 15-17 among the wires. Since terminals 4 connected to the ends of the other wires 1<sub>1</sub>, 1<sub>2</sub>, 1<sub>3</sub>, 1<sub>4</sub>, and 1<sub>8</sub> are inserted and fitted in hybrid connectors  $C_1'$ ,  $C_2'$ ,  $C_3'$ , and  $C_4'$  by being respectively mixed with the wires of the other partial harnesses  $H_B$  and  $H_C$ , these terminals 4 are in an exposed state.

[0056] Similarly, a proper connector  $C_2$  is fitted to one end of a group of electric wires 2 of the partial harness  $H_B$ , while electric wires 2<sub>1</sub>, 2<sub>2</sub>, 2<sub>3</sub>, 2<sub>4</sub>, 2<sub>5</sub>, 2<sub>6</sub>, and 2<sub>7</sub> on the other end side extend to corresponding hybrid connectors  $C_1'$ ,  $C_2'$ , and  $C_3'$ , respectively. The terminals 4 connected to the respective ends are exposed.

[0057] In addition, a proper connector  $C_3$  is fitted to one end of a group of electric wires 3 of the partial harness  $H_C$ , while a proper connector  $C_4$  is fitted to wires 3<sub>1</sub>, 3<sub>2</sub>, and 3<sub>3</sub> on the other end side, and the remaining wires 3<sub>4</sub>, 3<sub>5</sub>, 3<sub>6</sub>, 3<sub>7</sub>, and 3<sub>8</sub> extend to corresponding hybrid connectors  $C_3'$  and  $C_4'$ , respectively. The terminals 4 connected to the respective ends are exposed.

[0058] Thus, the connectors  $C_1$ ,  $C_2$ , and  $C_3$  proper to the relevant partial harnesses are respectively fitted to one ends of the groups of wires 1, 2, and 3 which respectively make up the partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$ , and the other end sides of the groups of wires are provided with the terminals 4 in the hybrid connectors  $C_1'$  to  $C_4'$ . At the same time, proper connectors such as the connectors  $C_4$  and  $C_5$  are fitted, as required, to the wires in which other partial harnesses are not present in mixed form.

[0059] FIGS. 3A to 3C show states in which the groups of wires 1, 2, and 3 of the partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$  corresponding to FIGS. 2A to 2C are respectively retained by wire clamps 100 of a wire clamping bar 101 shown in FIG. 13.

[0060] In FIG. 3A, all one ends of the group of wires 1 which make up the partial harness  $H_A$  are collectively retained on the right end side in the drawing of the wire clamping bar 101, and the proper connector  $C_1$  is thus fitted. The other end sides of the group of wires 1 are respectively retained in U-shapes with appropriate intervals so as to correspond to the hybrid connectors  $C_1'$  to  $C_4'$  and the proper connector  $C_5$ , respectively.

[0061] Namely, the two wires 1<sub>1</sub> and 1<sub>2</sub> are retained close to the proper connector  $C_1$ , one wire 1<sub>8</sub> is retained on the left end side, and the wires 1<sub>3</sub>, 1<sub>4</sub>, and 1<sub>5</sub>, 1<sub>6</sub>, and 1<sub>7</sub> are retained between them consecutively from the right-hand side. Of these wires, as explained with reference to FIG. 2A, the terminals (not shown) at opposite ends of the three wires 1<sub>5</sub> to 1<sub>7</sub> are already inserted and fitted in the proper connectors  $C_1$  and  $C_5$ , and the terminals 4 at the ends of the remaining wires 1<sub>1</sub> to 1<sub>4</sub> and 1<sub>8</sub> are in an uninserted state. It should be noted that the group of wires 1 on the proper connector  $C_1$

side and the wires 1<sub>3</sub> to 1<sub>7</sub> of the proper connector C<sub>5</sub> should preferably be retained in a vertical row by one wire clamp 100 after the insertion and fitting of the terminals to the connectors, as will be explained later.

[0062] Since the retention of the other partial harnesses H<sub>B</sub> and H<sub>C</sub> in the wire clamping bar 101 in FIGS. 3B and 3C is carried out in the same way as the partial harness H<sub>A</sub>, a description thereof will be omitted.

[0063] In the partial harness H<sub>A</sub> in FIG. 3A, the proper connectors C<sub>1</sub> and C<sub>5</sub> are already fitted to required portions of the group of wires 1, but the connectors C<sub>1</sub>' and C<sub>5</sub>' may be fitted in a wire-harness fabricating station which will be described later. If, to the contrary, not only the aforementioned proper connectors C<sub>1</sub> and C<sub>5</sub> but the hybrid connectors C<sub>1</sub> to C<sub>4</sub>' are fitted advance in the stage of the partial harness H<sub>A</sub>, the number of uninserted terminals in the partial harness H<sub>A</sub> can be reduced to an extremely small level.

[0064] In addition, if the hybrid connector C<sub>1</sub>', for example, is a waterproof connector, waterproof rubber caps (not shown) should preferably be applied in advance to its connection wires 1<sub>1</sub> and 1<sub>2</sub> in the stage of the partial harness H<sub>A</sub> before connection to the terminals 4.

[0065] It should be noted that wires which are stripped at one ends or both ends and whose terminals are unconnected may also be retained at the wire clamping bar 101 of the partial harness H<sub>A</sub> in preparation for the crimping or jointing of terminals of special sizes.

[0066] The other partial harnesses H<sub>B</sub> and H<sub>C</sub> are arranged in the same way as the partial harness H<sub>A</sub>.

[0067] Since the partial harnesses H<sub>A</sub>, H<sub>B</sub>, and H<sub>C</sub> shown in FIGS. 2A to 2C and FIGS. 3A to 3C can be fabricated by using a conventional apparatus such as a case fitting station 103 shown in FIG. 13 and in accordance with a conventional method as described above, a detailed description of the manufacture of the partial harness itself will be omitted.

[0068] FIG. 4 is an explanatory diagram of a wire-harness fabricating station 10 illustrating an embodiment of a wire-harness manufacturing apparatus in accordance with the present invention, as well as a partial-harness placing rack 8 and an empty-bar placing rack 9.

[0069] The station 10 is provided with a stand 11 for supporting and fixing the wire clamping bar 101 on this side, a connector setting table 12 in the middle, and a supporting frame 13 on the rear side. Arranged on the connector setting table 12 are a connector receiving jig 20 for the hybrid connectors C<sub>1</sub>' to C<sub>4</sub>' and connector receiving jigs 30 for the proper connectors C<sub>1</sub> to C<sub>5</sub>.

[0070] In addition, a connector transferring device 40 and a mounting head 108 of the aforementioned automatic terminal inserting device 107 (see FIGS. 13 and 14) are mounted on the supporting frame 13 in such a manner as to be movable in parallel to the frame 13. It should be noted that the pair of terminal gripping claws 109, the pair of wire gripping claws 110, and the pair of wire clamp plates 111 are openably provided on this mounting head 108 in such a manner as to be capable of being raised or lowered between the stand 11 and the connector setting table 12 and capable of moving close to or away from the same.

[0071] Next, referring to FIGS. 4 and 5, a description will be given of a method of manufacturing one wire harness WH from a plurality of partial harnesses H.

[0072] First, as shown in the flowchart in FIG. 5, in Step S1, the partial harnesses H<sub>A</sub>, H<sub>B</sub>, and H<sub>C</sub> fabricated in a known method as described above are consecutively transported, and are placed and stocked on the partial-harness placing rack 8 located in front of the wire-harness fabricating station 10 in accordance with the processing order (Step S2).

[0073] Next, in Step S3, the initial partial harness H<sub>A</sub> among the stocked partial harnesses H is transferred to the stand 11 of the station 10 by an unillustrated transfer hand.

[0074] At the same time as this transfer or prior to the transfer, the hybrid connectors C<sub>1</sub>' to C<sub>4</sub>' to be fitted to the wire harness WH are set in a horizontal row in the connector receiving jig 20 of the station 10.

[0075] In Step S4, the uninserted terminals 4 of the transferred partial harness H<sub>A</sub> are respectively inserted and fitted into terminal accommodating chambers 5 of predetermined hybrid connectors C' (case fitting). The insertion and fitting is automatically effected by the aforementioned automatic terminal inserting device 107, and control is provided such that entanglement with the inserted wires is reduced and the traveling and operating time of the device 107 is minimized. Namely, the case fitting is effected by repeating the step of inserting the terminals 4 of the predetermined wires 1 consecutively into the predetermined terminal accommodating chambers 5 of the predetermined hybrid connectors C'. For instance, as shown in FIGS. 2A and 2B, in a case where the hybrid connector C<sub>1</sub>' has five terminal accommodating chambers 5 (a to e) in two upper and lower stages, the terminals 4c and 4d of the wires 1<sub>1</sub> and 1<sub>2</sub> are inserted into the c-th and d-th terminal accommodating chambers 5. Then, the a-th, b-th, and e-th terminal accommodating chambers 5 in the middle are left vacant in preparation for the terminals 4a, 4b, and 4e of the wires 2<sub>1</sub> to 2<sub>3</sub> of the ensuing partial harness H<sub>B</sub>.

[0076] In Step S5, with respect to the partial harness H<sub>A</sub> for which case fitting has been completed, since the proper connectors C<sub>1</sub> and C<sub>5</sub> are held on the wire clamping bar 101 through the group of wires 1, these proper connectors C<sub>1</sub> and C<sub>5</sub> are transferred to the connector receiving jigs 30 by the connector transferring device 40. As a result, the wire clamping bar 101 becomes empty.

[0077] It should be noted that a detailed description will be given later of the holding of the proper connectors C<sub>1</sub> and C<sub>5</sub> by the wire clamping bar 101, as well as the connector receiving jigs 30 and the connector transferring device 40. In addition, as will be easily understood, the order of the steps of case fitting in Step S4 and the transfer of the proper connectors in Step S5 may be reversed.

[0078] In Step S6, the wire clamping bar 101 which has been emptied of the partial harness H<sub>A</sub> is transferred, and is stocked on the empty-bar placing rack 9, for example.

[0079] In step S7, a determination is made as to whether or not there is any untransferred partial harness H in the wire-harness fabricating station 10. If YES is the answer, Steps S3 to S6 are repeated, whereas if NO is the answer, all the process ends, and the completed wire harness WH is

obtained. In this embodiment, following the partial harness  $H_A$ , Steps S3 to S6 are consecutively repeated with respect to the partial harnesses  $H_B$  and  $H_C$ .

[0080] The flowchart shown in FIG. 6 is for the case of jointing the wires when the partial harnesses H are processed by the wire-harness fabricating station 10.

[0081] In this case, the step of preparing wires for jointing (Step S5') is added between the aforementioned Steps S5 and S6, and the step of collectively jointing the joint wires (Step S8) is added after Step S7.

[0082] As for the preparation of the wires for jointing in Step S5', in a case where wires which are stripped at one ends or both ends and do not have terminals are retained in U-shapes at the wire clamping bar 101 in the stage of each partial harness H, the stripped portions are removed from the wire clamp 100, are placed on a single clamp or an anvil of a welding machine (neither are shown) set on the connector setting table 12, and are consecutively secured temporarily thereby. In a final Step S8, these stripped portions are collectively jointed by one of various methods. The jointing can be effected by a known method such as crimping, soldering, or ultrasonic welding.

[0083] Incidentally, instead of being retained at the wire clamping bar in the stage of the partial harness H, the wires for jointing may be carried in from another stock site and may be retained for the first time after the processing in Step S5 for the partial harnesses  $H_A$ ,  $H_B$ , and  $H_C$  is completed. In addition, it is possible to effect attachment or terminal processing of special wires, such as shielded wires, instead of the wires for jointing or in conjunction with such wires.

[0084] In the flowcharts shown in FIGS. 5 and 6, although a description has been given of the example in which the partial harnesses H are temporarily stocked on the partial-harness placing rack 8 in Step S2, the partial harnesses H may be consecutively transported from the place of fabrication of the partial harnesses by omitting Step S2, and may be directly transferred to the wire-harness fabricating station 10.

[0085] FIGS. 7A and 7B show the connector receiving jig 20 for the hybrid connectors C', in which FIG. 7A is a perspective view thereof and FIG. 7B is a cross-sectional view of an air cylinder 23. FIG. 8 shows an exploded perspective view of the air cylinder 23.

[0086] The connector receiving jig 20 is a substantially U-shaped frame member which is made up of a base 21, a pair of upright side plates 22 and 22' on both sides, and coming-off prevention pieces 22a formed by being bent into L-shapes at upper ends and rear ends of the side plates. The base 21 is formed in such a manner as to be elongated in the horizontal direction so as to be able to collectively support and fix the hybrid connectors C', i.e., four hybrid connectors  $C_1'$  to  $C_4'$  in the illustrated example, in a horizontal row, but may be formed in a compact size to fix each of the individual hybrid connectors  $C_1'$ ,  $C_2'$ , . . . . Further, an attaching window (not shown) is provided on one side plate 22 (the right-hand side plate in the drawing) of the connector receiving jig 20, and an air cylinder unit 23 for tightening and fixing the hybrid connectors C' is attached thereto.

[0087] As shown in FIGS. 7B and 8, the air cylinder unit 23 is constructed such that a piston 27 is slidably fitted in a

cylinder 25, which is formed by a front cover 24 and a rear cover 24', via a spring 26, and a piston bar 27a is caused to project and retract through a hole 24a in the front cover 24, so as to fix the hybrid connectors C' by causing a tip of the piston bar 27a to press the hybrid connectors C' against the other side plate 22'. In the drawings, reference numeral 28 denotes an air tube; 28a, a joint; and 29, a screw 29.

[0088] Incidentally, the stroke of the piston bar 27a is sufficient if it is 1 to 2 mm or thereabouts, and it suffices if the stroke makes it possible to effect smooth insertion and withdrawal of the hybrid connectors C' with respect to the connector receiving jig 20 and effect sufficient tightening, fixing, and positioning.

[0089] Thus, since the connector receiving jig 20 having a fixing means such as the air cylinder unit 23 is provided on the connector setting table 12, the attachment and removal of the plurality of hybrid connectors  $C_1'$  to  $C_4'$  can be easily performed automatically or manually, and the hybrid connectors  $C_1'$  to  $C_4'$  can be secured positively.

[0090] FIG. 9 shows the connector transferring device 40 and the connector receiving jig 30 for the proper connector C.

[0091] The connector receiving jig 30 has a pair of mutually opposing U-shaped side plates 31 and 31' for inserting or removing the proper connector C in the vertical direction. An air cylinder unit 32 is attached to one side plate 31. Since this air cylinder unit 32 is similar to the above-described air cylinder unit 23, a description thereof will be omitted.

[0092] The connector transferring device 40 has a mounting base 41 which is mounted perpendicular to the supporting frame 13 in the wire-harness fabricating station 10 and in such a manner as to be horizontally movable with respect to the frame 13.

[0093] A horizontally moving plate 43, which advances or retracts in parallel to the base 41 by means of a cylinder 42, is slidably mounted on the mounting base 41, and a raising/lowering plate 45, which reciprocates vertically by means of a cylinder 44, is mounted on the horizontally moving plate 43. Attached to the raising/lowering plate 45 are a clamp head 47 having a pair of openable wire clamp plates 46 as well as a hand head 49 having a pair of openable connector hands 48. In the drawing, reference numerals 41a and 43a denote guide rails, respectively.

[0094] Next, referring to FIGS. 10A to 10D, a description will be given of the transfer of the proper connector C to the connector receiving jig 30 in the aforementioned Step S5.

[0095] First, by moving the mounting base 41 in parallel to the supporting frame 13, as shown in FIG. 10A, the connector transferring device 40 is stopped immediately above the wire clamp 100 where the proper connector  $C_1$  and its group of wires 1 are retained vertically at the wire clamping bar 101 for the partial harness  $H_A$ , and the wire clamp plates 46 and the connector hands 48 are lowered in open states by means of the cylinder 44.

[0096] Next, as shown in FIG. 10C, through the aforementioned parallel movement of the mounting base 41 and the driving of the cylinder 42, the proper connector  $C_1$  gripped by the connector hands 48 is moved to immediately above the connector receiving jig 30.

[0097] Finally, as shown in FIG. 10D, the connector hands 48 are lowered by the driving of the cylinder 44, the proper connector  $C_1$  is inserted between the pair of side plates 31 and 31' of the connector receiving jig 30, and the proper connector  $C_1$  is fixed by the air cylinder unit 32. As a result, the transfer of the proper connector  $C_1$  from the wire clamping bar 101 to the wire-harness fabricating station 10 is completed.

[0098] It should be noted that if it is unnecessary to insert a terminal into the proper connector, there is no need for fixing and positioning the connector inside the connector receiving jig 30 by means of the air cylinder unit 32, and it suffices if the connector does not fall off the connector receiving jig 30.

[0099] As described above, in the wire-harness fabricating station 10, if a plurality of connector receiving jigs 30 are set so that the proper connectors  $C_1$  to  $C_5$  fitted to the partial harnesses H can be fixed or placed in vertically oriented states, it is possible to reduce the space for the connector setting table 12, hence, the station 10 itself, and to reduce the traveling distance necessary for processing by the aforementioned automatic terminal inserting device 107 and the connector transferring device 40.

[0100] FIG. 11 shows a second connector transferring device 50 used in the stage of fabrication of each partial harness H.

[0101] In the conventional case fitting station 103 shown in FIG. 13, a plurality of connectors 105<sub>1</sub> to 105<sub>5</sub> are arranged in horizontally oriented states on a setting table 106.

[0102] Accordingly, the proper connectors C ( $C_1$  to  $C_5$ ) of the partial harnesses ( $H_A$ ,  $H_B$ , and  $H_C$ ) in the present invention are also held in horizontally oriented states on the wire clamping bar 101, as shown in FIGS. 2A to 2C. However, these proper connectors C together with the wires should be preferably retained and held in vertically oriented states, as described above with reference to FIGS. 10A to 10D.

[0103] Therefore, the station for manufacturing the partial harnesses H in the present invention is equipped with the connector transferring device 50, and it is recommended that the wires for which casing fitting has been completed and the proper connectors C be held in vertically oriented states in the stage of the partial harness H.

[0104] The second connector transferring device 50 has, for example, a mounting base 51 which is mounted perpendicular to a supporting frame 114 in the case fitting station 103 in FIG. 13 and in such a manner as to be horizontally movable with respect to the frame 114.

[0105] A raising/lowering plate 53, which moves vertically by means of a cylinder 52, is slidably mounted on the mounting base 51, and a horizontally moving plate 54, which advances or retracts in parallel to the raising/lowering plate 53 by means of a cylinder 52', is mounted on the raising/lowering plate 53. Further, a rotary head 57, which rotates 90° by means of a pulley 56 by the rotation of a motor 55, is pivotally attached to a front plate portion 54a of the horizontally moving plate 54. A clamp head 59 having a pair of openable wire clamp plates 58 is fixed to the rotary head 57.

[0106] It should be noted that the setting table 106 should be preferably provided with a connector receiving jig 115 for the proper connector C and a cylinder 52", for advancing and retracting the same.

[0107] Next, referring to FIG. 11 and FIGS. 12A to 12D, a description will be given of the transfer of the proper connector C in the partial harness H.

[0108] In FIGS. 11 and 12A, the proper connector C in a horizontally oriented state is fitted to the ends of the group of wires 1, and the connector C is held in the connector receiving jig 115. The pair of wire clamp plates 58 has an opening extending in the horizontal direction, and is located in such a manner as to clamp the group of wires 1 from upper and lower directions. Further, the retention of the group of wires 1 by the wire clamp 100 has been canceled.

[0109] Next, as shown in FIG. 12B, in a state in which the upper and lower wire clamp plates 58 are closed to grip the group of wires 1, the connector receiving jig 115 is retracted by the actuation of the cylinder 52" and moves away from the proper connector C.

[0110] Next, as shown in FIG. 12C, at a position where the wire clamp plates 58 have been sufficiently raised by the actuation of the cylinder 52, the rotary head 57, i.e., the wire clamp plates 58, is rotated 90° by the driving of the motor 55. This sets the group of wires 1 and the proper connector C in a vertically oriented state.

[0111] Finally, as shown in FIG. 12D, the wire clamp plates 58 are lowered, and inserts and retains the group of wires 1 in a vertical row into a desired wire clamp 100 (between a pair of clamp members 100a). As a result, in the stage of the partial harness H, it is possible to obtain the partial harness H in which the proper connector C is held in a vertical state.

[0112] As described above, by virtue of the second connector transferring device 50, it is possible to obtain the partial harness H in which the proper connector C is held in a vertical state with respect to the wire clamping bar 101.

[0113] Although, with reference to FIG. 11 and FIGS. 12A to 12D, a description has been given of the example in which the connector receiving jig 115 is provided in such manner as to be capable of advancing and retracting by means of the cylinder 52", an arrangement may be provided such that, instead of the connector receiving jig 115, the connector transferring device 50 is advanced or retracted by the cylinder 52', and the proper connector C together with the group of wires 1 is pulled out from the receiving jig 115.

What is claimed is:

1. A wire harness comprising a plurality of partial harnesses,

wherein each of the partial harnesses is arranged such that opposite end portions of a plurality of electric wires having terminals at ends thereof are retained in advance in U-shapes with predetermined intervals provided so as to correspond to a plurality of connectors into which the terminals are inserted, by a plurality of wire clamps juxtaposed at equal pitches on a wire clamping bar, and

wherein the terminals at the ends of the plurality of electric wires in each of the partial harnesses are inserted into terminal accommodating chambers of

predetermined connectors selected from the plurality of connectors, thereby aggregating the plurality of partial harnesses into a combined unit.

2. A wire harness according to claim 1, wherein the plurality of connectors into which the terminals are inserted comprise at least one of connectors proper to a relevant partial harness into which only the terminals of the plurality of electric wires making up each of the partial harnesses are inserted and hybrid connectors into which the terminals of the electric wires of two or more of the partial harnesses are inserted in mixed form.

3. A wire harness according to claim 1, wherein the proper connector is fitted in advance to the ends of predetermined ones of the electric wires of each of the partial harnesses.

4. A wire harness according to claim 1, wherein the hybrid connector is fitted in advance to the ends of the electric wires of one or two of the partial harnesses selected from the plurality of partial harnesses.

5. A wire harness according to claim 1, wherein each of the partial harnesses includes electric wires to stripped ends of which terminals are unconnected, and the stripped ends thereof are jointed in the aggregated state.

6. A method of manufacturing a wire harness from the plurality of partial harnesses, comprising:

a step of transferring a wire clamping bar which holds an initial one of the partial harnesses to a wire-harness fabricating station;

a step of inserting the terminals at ends of a plurality of electric wires consecutively into predetermined terminal accommodating chambers of predetermined ones of the connectors selected from the plurality of connectors set on a connector receiving jig in the wire-harness fabricating station;

a step of removing the wire clamping bar which has been emptied; and

repeating the steps of transferring, inserting and removing consecutively for ensuing ones of the partial harnesses.

7. A method of manufacturing a wire harness according to claim 6, further comprising a step of transferring a proper connector fitted in advance to ends of predetermined ones of the electric wires of each of the partial harnesses to the connector receiving jig in the wire-harness fabricating station.

8. A method of manufacturing a wire harness according to claim 6, further comprising a step of collectively jointing, in the wire-harness fabricating station, two or more stripped portions of the electric wires included in each of the partial harnesses.

9. A method of manufacturing a wire harness according to claim 7, further comprising a step of collectively jointing, in the wire-harness fabricating station, two or more stripped portions of the electric wires included in each of the partial harnesses.

10. A method of manufacturing a wire harness according to claim 6, further comprising a step of jointing, in the wire-harness fabricating station, stripped portions of the ends of the electric wires included in each of the partial harnesses, such that the stripped portions are consecutively superposed one on top of another each time each of the partial harnesses is transferred to the wire-harness fabricating station.

11. A method of manufacturing a wire harness according to claim 7, further comprising a step of jointing, in the wire-harness fabricating station, stripped portions of the ends of the electric wires included in each of the partial harnesses, such that the stripped portions are consecutively superposed one on top of another each time each of the partial harnesses is transferred to the wire-harness fabricating station.

12. An apparatus for manufacturing a wire harness, comprising:

a wire-harness fabricating station for forming a single wire harness from partial harnesses, the wire-harness fabricating station having a connector receiving jig which detachably holds a plurality of proper connectors and a plurality of hybrid connectors.

13. An apparatus for manufacturing a wire harness according to claim 12, wherein the wire-harness fabricating station comprises a connector transferring device for transferring, to the connector receiving jig, ones of the proper connectors and hybrid connectors which are fitted in advance to the partial harness.

\* \* \* \* \*





several kinds of designation data to create an operation instruction file;

a third computer checking the operation instruction file against a master file to create a data file available for all manufacturing steps;

a fourth computer allotting file data processed by the third computer to each wire clamping pole,

a plurality of servers supplying the file data to the downstream network;

a plurality of information terminal devices which are connected to the servers to requite data necessary for actual operations and provide each designation signal to said designating portion; and

a scanner connected to each of said information terminal devices, for supplying the number of the clamping pole to a certain information terminal device, wherein said first, second, third and fourth computers are connected to said server through a bus line and constitute said upstream network.

2. A wire harness manufacturing system according to claim 1, wherein a predetermined accessory in an accessory shelf and a predetermined wire in a wire stocker are designated by an output signal from one of said information terminal devices.

3. A wire harness manufacturing system according to claim 1, wherein a predetermined terminal crimping machine or joint terminal machine are designated and automatically set up by one of said information terminal devices.

4. A wire harness manufacturing system according to claim 1, wherein a

predetermined connector housing in a connector shelf is designated and a terminal insertion position of the connector housing is designated by an output signal from one of said information terminal devices.

5. A wire harness manufacturing system according to claim 1, further comprising an automated wire cutting machine which is controlled by a first personal computer, wherein said personal computer is supplied with said data and an identifying number of said wire clamping pole from the scanner.

6. A wire harness manufacturing system according to claim 1, further comprising an automated peeling machine which is controlled by a second personal computer, wherein said second personal computer is supplied with said data and an identifying number of said wire clamping pole from the scanner.

7. A wire harness manufacturing system according to claim 1, wherein said wire clamp position designating jig, each information terminal device and scanner are loaded on a moving cart which is movable in each of steps of the wire harness manufacturing system.

8. A wire harness manufacturing system according to claim 1, wherein said designation data comprise clamp position data.



US005884393A

**United States Patent** [19]

Miyazawa

[11] **Patent Number:** 5,884,393[45] **Date of Patent:** Mar. 23, 1999[54] **MOUNTING JIG FOR ELECTRICAL CONNECTORS**[75] **Inventor:** Junichi Miyazawa, Yokohama, Japan[73] **Assignee:** Molex Incorporated, Lisle, Ill.[21] **Appl. No.:** 689,753[22] **Filed:** Aug. 13, 1996[30] **Foreign Application Priority Data**

Oct. 5, 1995 [JP] Japan ..... 7-011583

[51] **Int. Cl.<sup>6</sup>** ..... H05K 13/00[52] **U.S. Cl.** ..... 29/739; 29/759; 29/760[58] **Field of Search** ..... 29/757, 755, 739,  
29/741, 759, 758, 832, 842, 760[56] **References Cited****U.S. PATENT DOCUMENTS**

3,641,666 2/1972 Scaminaci, Jr. et al. .... 29/629

3,680,193 8/1972 Scaminaci et al. .

4,394,795 7/1983 Goss .

5,351,391 10/1994 Doutrich et al. .

**FOREIGN PATENT DOCUMENTS**

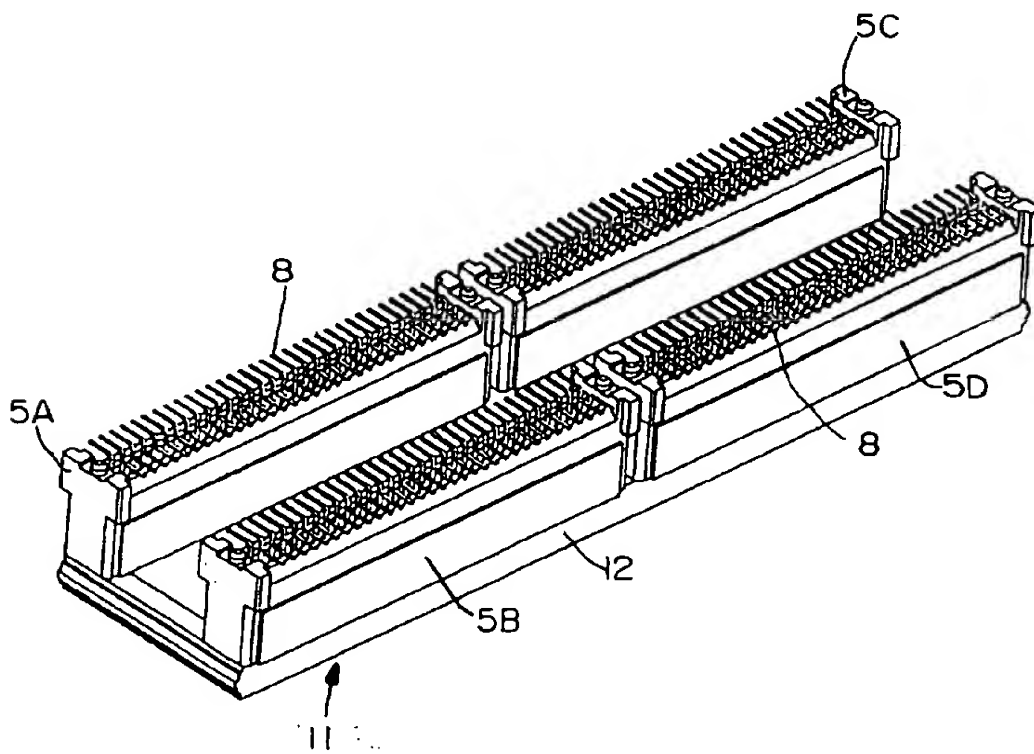
0042692 12/1981 European Pat. Off. .

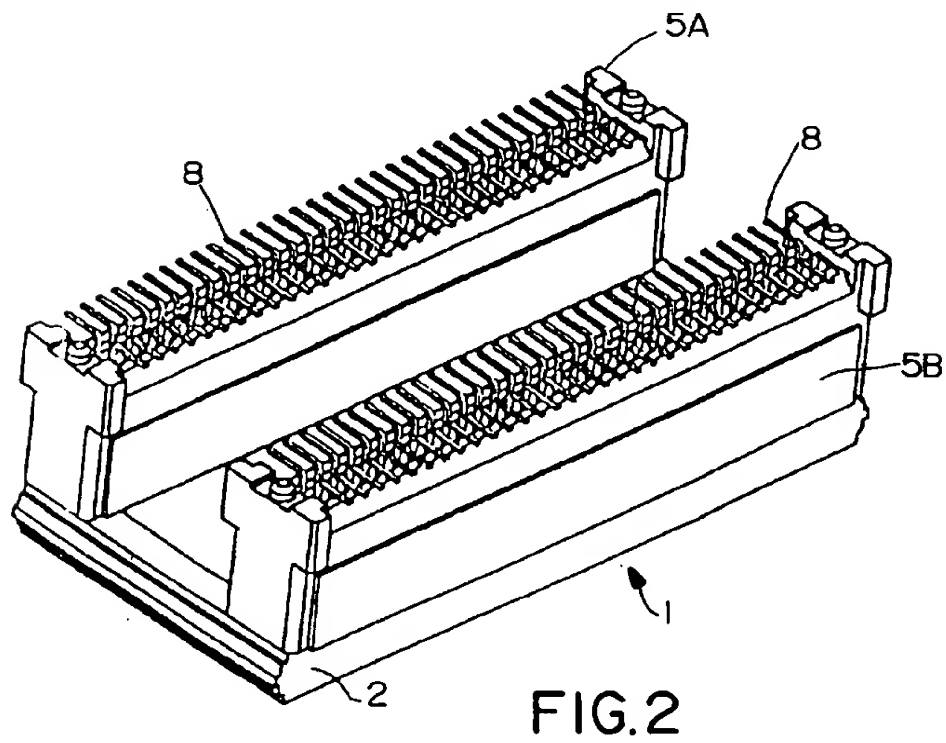
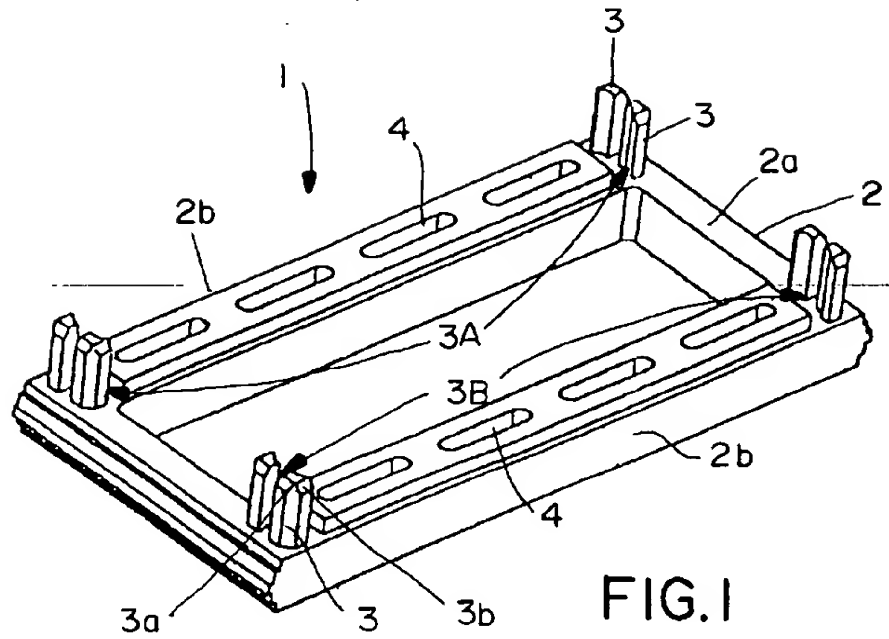
0237728 9/1987 European Pat. Off. .

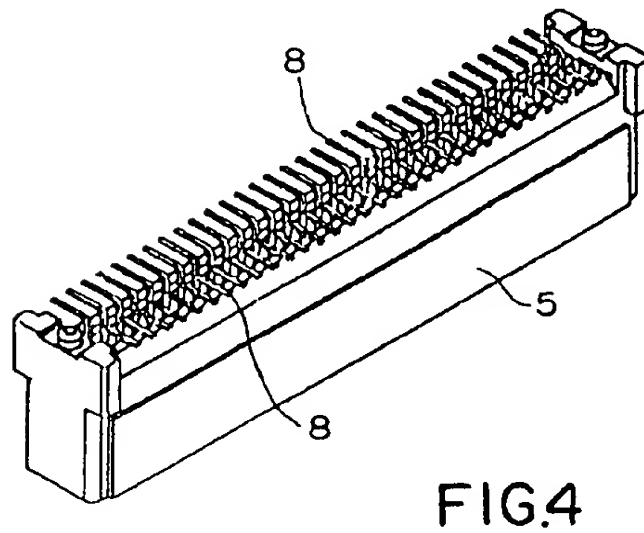
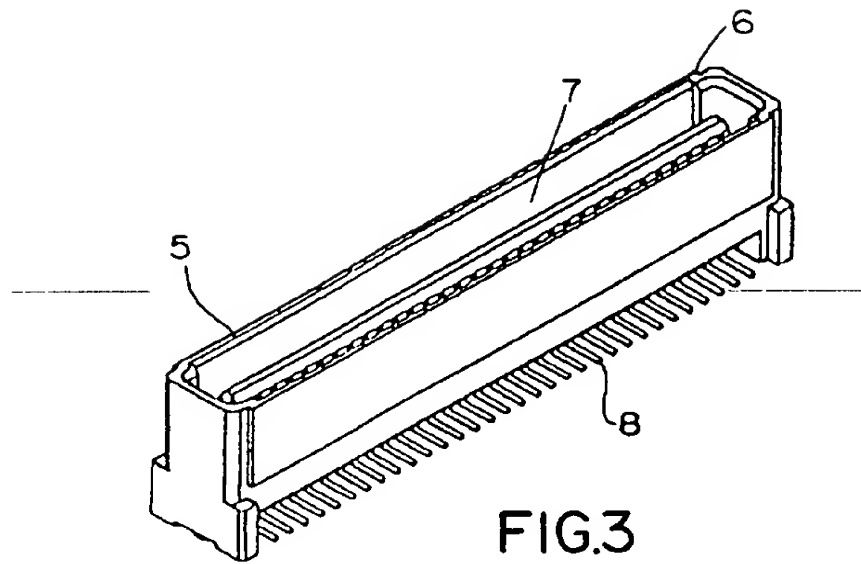
5135835 1/1993 Japan .

*Primary Examiner*—Carl E. Hall*Attorney, Agent, or Firm*—Charles S. Cohen[57] **ABSTRACT**—

Connector mounting jigs for simultaneously positioning and mounting a plurality of electrical connectors on a printed circuit board include a base member, and at least two sets of pairs of synthetic resin posts extending from one surface of and formed integrally with the base member for frictional engagement of respective corners of a cavity of each connector to support respective connectors in a predetermined positional relationship to each other.

**19 Claims, 3 Drawing Sheets**





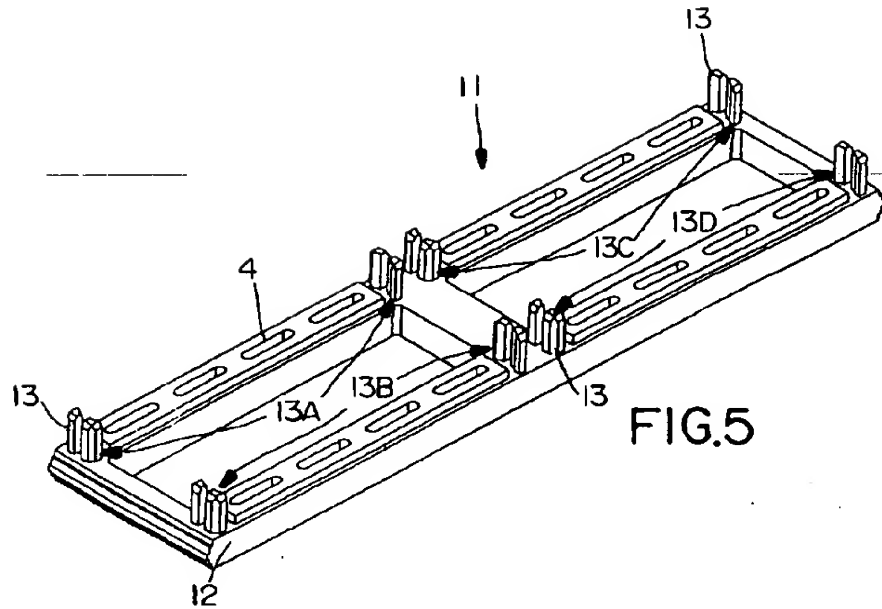


FIG. 5

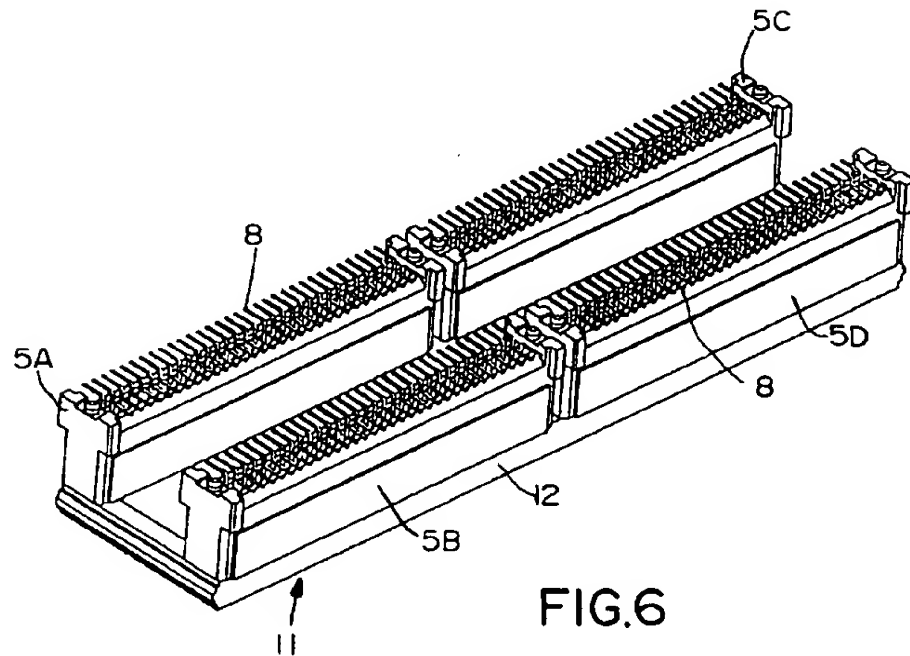


FIG. 6

## MOUNTING JIG FOR ELECTRICAL CONNECTORS

### BACKGROUND OF THE INVENTION

The present invention relates generally to a jig for mounting a plurality of electrical connectors to be used for connecting a pair of printed circuit boards.

Conventionally, electrical connections between a first printed circuit board (motherboard) and another printed circuit board (daughterboard) may be established through the use of electrical connectors. In the past, one receptacle or female connector has been mounted on one printed circuit board, and an electrical plug or male connector is mounted on the other printed circuit board. By mating and connecting the female connector receptacle and the plug male connector with each other, electrical communication between the respective printed circuit boards is established. However, in the recent years, the number of required terminals or circuits is increasing due to the desire for down-sizing, reduction of weight of the electronic equipment and for higher performance. Accordingly, it now has become necessary on frequent occasions to mount a plurality of electrical connectors on each of the printed circuit boards.

When a plurality of electrical connectors are to be mounted on the surface of one of the printed circuit boards, it is important to be able to precisely position the respective connectors which are to be mounted to the same circuit board relative to each other. If they are not precisely positioned, the subsequent engagement between the electrical female connector receptacles and the electrical plug male connectors becomes difficult. Moreover, the solder tails of the respective connectors and the circuits on the circuit boards to which they are to be soldered might be misaligned to the extent that could result in the failure to complete circuits which should have been completed.

Various methods have been employed in the past to avoid such problems. One such prior method for positioning of the connectors is by setting a guide block which is designed to accommodate the connectors therein on the printed circuit board as is disclosed in Japanese Unexamined Patent Publication (Kokai) No. Heisei 5-47443. Another method connects two connectors by means of a bridge for fixing the relative portions of the connectors as is disclosed in 0.5 mm Pitch Multi-Pole Board-to-Board Connector, Electronics Mounting Technology, Vol. 10, No. 10, pp. 72-73.

Another known method is to restrict the relative positions of a plurality of connectors by employing a jig having cavities to externally engage with the connectors is disclosed in Japanese Unexamined Patent Publication No. 5-135835.

Among the prior art set forth above, the methods employing the guide block or the bridge have a problem of consuming spacial volume on the circuit board that might otherwise have a functional use because the guide block or the bridge is mounted on the printed circuit board together with the connectors. On the other hand, in the case of the aforementioned method employing the jig, because a part of the jig is located outside of the connector, a space to accommodate the extending part of the jig must be provided during the mounting of the connector on the printed circuit board. Therefore, similar to the former case, this method still causes the waste and loss of what otherwise could be functional volume or space on the circuit board.

### SUMMARY OF THE INVENTION

In view of the aforementioned problems, it is an object of the present invention to provide a jig for mounting a

connector which can mount a plurality of connectors on a printed circuit board with high positioning accuracy and without sacrificing functional volume or space.

In one principal aspect of the invention a plurality of electrical connectors are positioned for mounting on a printed circuit board by providing a jig having a perimeter and at least four posts spaced from each other and positioned adjacent the perimeter of the jig. One of the connectors is positioned over two of the spaced posts so that the two spaced posts extend into at least one cavity in one of the connectors and engage the cavity to position and hold the connector on the jig and substantially at the perimeter of the jig. Another of the connectors is positioned over the other two spaced posts so that the other two spaced posts extend into at least one cavity of that connector and engage the cavity to position and hold the last mentioned connector on the jig, substantially at the perimeter of the jig and in a fixed predetermined relationship to the first connector. Once the connectors are mounted to the printed circuit board, the jig and posts are removed from the connectors.

In another principal aspect of the invention, the posts frictionally engage the cavity of the connectors.

In still another principal aspect of the invention, the posts deform to frictionally engage the cavity.

In still another principal aspect of the invention, the jig includes at least two sets of posts. Each of the sets of posts includes two pair of posts with each pair and each post in each said set being spaced from each other. Each set of posts and each post in each set is also positioned to coincide and conform to the cavity of a connector, and the one of the connectors is positioned over one of the sets of posts, and the other of the connectors is positioned over the other of the sets of posts.

In still another principal aspect of the invention, each of the posts in the last mentioned pairs of posts is deformable both in the direction of the other posts of the pair and the other pair of posts in the set.

In still another principal aspect of the invention, the aforementioned fixed predetermined relationship between the connectors may be in side by side relationship.

In still another principal aspect of the invention, at least one additional connector may be positioned on the jig in end to end relationship to at least one of the aforementioned connectors.

In still another principal aspect of the invention, the connectors have a cavity within the connector and each of the pair of posts is spaced from each other by a distance substantially equal to the length of the cavity of one of the connectors and one post of each pair is spaced from the other post of each pair by a distance substantially equal to the width of the cavity.

In still another principal aspect of the invention, the aforementioned connectors have a perimeter, and the posts are positioned within the maximum dimensions of the perimeters of the connectors when the connectors are positioned on the posts.

These and other objects, features and advantages of the present invention will be more clearly understood through a consideration of the following detailed description.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given herebelow and from the accompanying drawings of the preferred embodiment of the invention which are for explanation and understanding of the invention only and not limiting thereof, and in which:



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FIG. 1 is a perspective view of a first embodiment of a connector mounting jig constructed according to the principles of the present invention;

FIG. 2 is a perspective view of the first embodiment of the connector mounting jig in use to position a plurality of connectors for mounting to a circuit board;

FIG. 3 is a perspective view of a connector to be mounted by the first embodiment of connector mounting jig, and in which the connector is illustrated in an upright condition;

FIG. 4 is a perspective view of the connector substantially as shown in FIG. 3 to be mounted by the first embodiment of the connector mounting jig, but in which the connector is in the upside down condition;

FIG. 5 is a perspective view of a second embodiment of the connector mounting jig constructed according to the principles of the invention; and

FIG. 6 is a perspective view of the second embodiment of the connector mounting jig in use to position a plurality of connectors for mounting to a circuit board.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be discussed hereinafter in detail in terms of the preferred embodiments and with reference to the accompanying drawings.

A first embodiment of a connector mounting jig 1 according to the present invention is shown in FIG. 1. The connector mounting jig 1 has a base member 2 of generally polygonal shape, and more preferably of rectangular shape as seen in FIG. 1. The base member 2 is generally formed of shorter transversely extending pieces 2a and longer longitudinally extending side pieces 2b. Two pairs of posts 3 preferably extend upwardly from the upper (as shown in the drawings) surface at each end of the longer pieces 2b and at each corner of the base member 2 adjacent its perimeter to define two sets of pairs of posts 3A and 3B, as shown in FIG. 1, one set for each connector. The base member 2 and the posts 3 are preferably formed integrally with each other and of the same synthetic resin material. Through openings 4 also are preferably formed at given intervals as shown in FIG. 1 in the longer pieces 2b. Accordingly, if the frame of the base member 2 is formed of hollow construction, and the through openings 4 are formed through the longer pieces 2b, the base member 2 can be made light in weight. In addition, the openings reduce the shrinkage of the plastic base member which could affect the position of posts 3.

Each set of pairs of posts 3A and 3B is adapted to correspond with each of two connector components 5A and 5B, respectively, as shown in FIG. 2. Each connector 5 is illustrated in FIGS. 3 and 4. The posts 3 at the opposite ends of one longer piece 2b are adapted to be inserted in and engaged with a cavity in each connector component, such as internal cavity 7, and the posts are preferably formed and shaped to mate with mating surfaces in each connector such as mating surfaces 6, as viewed in FIG. 3. As shown in FIG. 1, two pair of posts, one at each end of a longer piece 2b of the base member 2 are preferably provided and each of the two sets 3A and 3B are engaged with each of the connectors 5A and 5B, respectively.

In order to insert the two pairs of posts 3 of a set of posts 3A or 3B into the receptacle cavity 7 while establishing frictional engagement with the peripheral surface of the receptacle cavity, and to release the posts from the receptacle cavity 7, each post 3 is preferably deformable both in the longitudinal direction of the longer piece 2b and in the

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direction perpendicular thereto, i.e., in the transverse direction perpendicular to the longitudinal direction of the connector 5. Each of the posts 3 is also preferably chamfered at their tips at 3a and 3b as shown in FIG. 1 to facilitate insertion of the posts 3 into the receptacle cavity 7.

FIG. 2 illustrates a condition where two connector components 5A and 5B are to be mounted on the printed circuit board by means of the first embodiment of the connector mounting jig 1 according to the invention. Each of two pairs of posts 3 at the respective opposite ends of the longer piece 2b of the base member 2, i.e., a set of posts 3A or 3B, are inserted into and engaged with the receptacle cavity 7 of the corresponding connector component 5. By maintaining this condition, two connector components 5A and 5B mounted on both longer pieces 2b of the base member 2 can be maintained at a fixed positional relationship in both the longitudinal and lateral directions. Therefore, by soldering the two connector components 5A and 5B on the printed circuit board while maintaining fixed positional relationship between the two connector components 5A and 5B, the relative positions of the two connector components on the printed circuit board 2 can be fixed with certainty and accuracy by the posts 3 of the connector mounting jig 1. As a result, two connector components 5A and 5B can be mounted on the printed circuit board with high precision.

While the connector component 5 shown in FIGS. 2-4 of the drawings is provided with the solder tails 8 adapted to be mounted on the surface of the printed circuit board by way of soldering, the connector mounting jig 1 according to the present invention is equally effective for mounting connectors of the type having solder tails that pass through holes formed in the printed circuit board.

After completion of mounting of the connector components 5A and 5B onto the printed circuit board, the connector mounting jig 1 is simply removed by removing and releasing the posts 3 from the receptacle cavities 7 by pulling the jig 1 away from connector components 5A and 5B. Accordingly, after the connector components 5A and 5B are mounted, the connector mounting jig 1 is no longer necessary and may be completely removed from the connector-printed circuit board assembly. Therefore, waste or loss of what otherwise might be functional space or volume is eliminated.

Furthermore, during mounting, no part of the connector mounting jig 1 extends beyond the extreme circumferential surfaces of the connector components 5, again avoiding the sacrifice or waste of mounting space or volume on the printed circuit board that might otherwise have a functional use. The distance between two pairs of the posts 3 at the same ends of the longer pieces 2b, i.e., two pairs of posts of the respective sets 3A or 3B, at all times corresponds to the desired distance between the respective connector components 5A and 5B. Therefore, either where the two connector components 5A and 5B are to be arranged as close as possible to each other or where the two connector components 5A and 5B are to be arranged at some predetermined distance, either spacing can be accurately maintained by the transverse distance between the two sets 3A and 3B of pairs of respective posts.

A second embodiment of connector mounting jig 11 according to the present invention is shown in FIGS. 5 and 6. In this embodiment two base members 2 of the first embodiment are connected in tandem fashion so that four connector components 5A, 5B, 5C and 5D (either receptacle or plug connector components), as seen in FIG. 6, may be mounted simultaneously on a printed circuit board. The base

member 12 of this embodiment is provided with eight pairs of posts 13 at respective corners, and also at the intermediate position to form four sets of posts 13A, 13B, 13C and 13D, as seen in FIG. 5. Similar to the first embodiment, the base member 12 and the posts 13 are preferably formed integrally with each other and of the same synthetic resin material.

In FIG. 6 the connector mounting jig 11 is shown in use. As seen in FIG. 6, four connector components 5A-5D are arranged in two parallel strings. Similar to the first embodiment, the positional relationship between the connector components 5A-5D can be fixed and maintained with accuracy and certainty. Therefore, the four connector components 5A-5D can be accurately mounted on a printed circuit board with precise positional relationship relative to each other. As in the first embodiment, the pairs of posts 13 are respectively inserted in and engaged into the respective corners of the connector components 5, and can be released therefrom after completion of mounting of the connectors 5A-5D onto the printed circuit board. By releasing the posts 13 from engagement with receptacle cavities 7 of the connector components, the connector mounting jig 11 can be removed.

It will be understood that while the two embodiments described herein are discussed in terms of mounting two or four connector components, the number of the connector components is not limited to the specific number described, but can be of any desired number, such as three, five, six, etc. In any case, the number of post sets to be provided on the base member may simply be adapted to the desired number of the connector components to be mounted. Additionally, it will be understood that although the embodiments discussed herein are illustrated using receptacle connector components which receive the mounting posts 3, 13 within an internal cavity within the sidewalls of the connector components, the posts may be received within similar internal cavities of male or plug connector components as well as external cavities of the connector component sidewalls. Moreover, it will also be understood that although some of the connector components 5 are shown in FIG. 6 in end to end relationship, they may also be arranged in side by side relationship, and while some are shown in side by side relationship in FIG. 2, they may also be arranged in end to end relationship.

It will also be understood that the preferred embodiments of the present invention which have been described are merely illustrative of the principles of the present invention. Modifications may be made by those skilled in the art without departing from the true spirit and scope of the invention.

I claim:

1. A connector mounting jig for simultaneously positioning a plurality of electrical connector components in a predetermined arrangement for subsequent mounting on a printed circuit board, each of the connector components having a body portion and at least one cavity extending within the connector component body portion, each said cavity having a predetermined width, each of said cavities having a predetermined width and each of said connector components having a predetermined exterior periphery, the connector mounting jig comprising:

a base member having an upper surface and a perimeter; at least two sets of resilient posts extending upward from said upper surface of said base member adjacent its perimeter, one of said sets of resilient posts being positioned in a predetermined relationship to the other set of posts on said base member, and each of said sets of posts comprising at least two pair of posts with each

of said pair of posts and each post being spaced from each other, each set of posts and each post in each set being positioned to coincide and conform with a corresponding cavity of one of said connector components, so that each of said sets of posts may be inserted in and engage the cavity of one of said connector components, each set of posts frictionally engaging surfaces of said connector component cavity, to thereby firmly position and support the respective connector components on said base member in said predetermined relationship, said base member having a preset perimeter and said sets of resilient posts being disposed on said base portion in an arrangement such that, when said connector components are mounted to said base member, no portion of said base member of said mounting jig extends past said exterior peripheries of said connector components.

2. The connector mounting jig of claim 1, wherein said base member is formed of a synthetic resin, and said posts and said base are formed integrally with each other.

3. The connector mounting jig of claim 1, wherein said base member is of a polygonal frame-shaped configuration.

4. The connector mounting jig of claim 3, wherein said configuration is rectangular.

5. The connector mounting jig of claim 1, wherein said posts are arranged for supporting at least two of said connectors in a fixed positional side by side relationship to each other.

6. The connector mounting jig of claim 5, wherein said posts are also arranged for supporting at least two additional connector components in fixed positional end to end relationship to said side by side connectors.

7. The connector mounting jig of claim 1, wherein said posts are arranged for supporting at least two of said connectors in fixed positional end to end relationship to each other.

8. The connector mounting jig of claim 1, wherein each resilient post is deformable in the directions of both the other pair of posts on the set and the other post in each pair.

9. The connector mounting jig of claim 1, wherein said base member comprises:

a frame having elongate frame components oriented in a given direction for arranging and positioning said connector components relative to each other, at least some of said frame components having openings disposed therein between distinct sets of said posts for lightening the jig.

10. The connector mounting jig of claim 1, wherein each cavity of said connector components includes a length and width entirely contained within said connector component body portion, and each of said pair of posts in a distinct set of said posts is spaced from each other by a distance substantially equal to the length of said connector component cavity, and one post of each said pair is spaced from the other post of each said pair of posts by a distance substantially equal to the width of said connector component cavity to thereby facilitate said frictional engagement of said connector component cavity by said sets of posts.

11. The connector mounting jig of claim 1, wherein the connector components have a perimeter having maximum dimensions, and said posts are positioned relative to each other to be within the maximum dimensions of the perimeter of the connector components when the connector components are positioned on the posts.

12. A combination comprising:

a plurality of electrical connectors, each of the connectors having a plastic body portion that defines, in part, an

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exterior periphery of said connector, each connector further including a plurality of spaced apart conductive terminals arranged along said sidewalls said conductive terminals extending out from said connector body portion into an arrangement for surface mounting said connector to a printed circuit board; and,

a connector mounting jig for supporting said connectors in a predetermined pattern for surface mounting of said connectors to a printed circuit board, including:

a base member having an upper surface and a perimeter, and

at least two distinct sets of posts extending upward from said upper surface of said base member, one of said distinct sets of posts being positioned in a predetermined relationship to the other distinct set of posts, and each of said distinct sets of posts comprising at least two pair of posts with each of said pair of posts and each post being spaced from each other, each set of posts and each post in each set being positioned apart a preselected distance from each other so that each of said distinct sets of posts frictionally engage said connector cavities when inserted in said connector cavities to thereby firmly position and support the respective connectors on said base member in a predetermined relationship to each other, said distinct sets of posts being disposed on said base member near said perimeter thereof whereby, when said connectors are supported on said connector mounting jig, no portion of said base member perimeter extends outwardly past said exterior peripheries of said connectors.

13. The combination of claim 12, wherein said base member is formed of a synthetic resin, and said posts and said base member are formed integrally with each other.

14. The connector of claim 12, wherein said base member is rectangular.

15. The combination of claim 12, wherein said posts support at least two of said connectors in a fixed positional side-by-side relationship to each other.

16. The combination of claim 15, wherein said posts support at least two of said connectors in fixed positional end to end relationship to said side-by-side connectors.

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17. The combination of claim 12, wherein said posts support at least two of said connectors in fixed positional end to end relationship to each other.

18. The combination of claim 12, wherein said posts are positioned on said base member and closely adjacent said base member perimeter.

19. A connector mounting jig for simultaneously positioning a plurality of electrical connector components in a predetermined arrangement for mounting onto a printed circuit board in a predetermined mounting area of the printed circuit board, said printed circuit board having a plurality of components arranged around said predetermined mounting area, each of the connector components having a body portion defining an exterior periphery of said connector component, and each of said connector components having at least one opening formed in said body portion thereof, the connector mounting jig comprising:

a base member having a predetermined perimeter;

a plurality of distinct sets of posts disposed on said base member adjacent said base member perimeter and extending upwardly from said base member, each distinct set of posts including at least two pair of posts, with each of said pair of posts and each post being spaced from each other, each pair of posts and each post in each said pair being positioned to coincide and conform with a corresponding opening of one of said connector components, so that each of said sets of posts may be inserted into said cavity of one of said connector components to engage opposite surfaces of said connector component cavity, to thereby firmly position and support the respective connector components on said base member in said predetermined relationship, said sets of posts being disposed on said base portion such that when said connector components are mounted to said base member, no portion of said base member extends past said exterior peripheries of said connector components.

\* \* \* \* \*

US-PAT-NO: 5774981

DOCUMENT-IDENTIFIER: US 5774981 A

\*\*See image for Certificate of Correction\*\*

TITLE: Terminal insertion method and apparatus

DATE-ISSUED: July 7, 1998

INVENTOR-INFORMATION:

NAME	STATE	ZIP CODE	COUNTRY	CITY
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Suzuki; Hiroo				Haibara-gun
N/A	N/A		JP	

US-CL-CURRENT: 29/861, 29/33M , 29/753 , 29/863

CLAIMS:

What is claimed is:

1. A method of inserting a terminal in a connector housing comprising the steps of:

picking out both terminal ends of each of terminal-equipped wires held by a plurality of clips by a pair of terminal insertion heads individually driven in both a Y-axis direction and an X-axis direction; and

simultaneously moving both terminal ends of each wire into said connector housing.

2. A method of inserting a terminal according to claim 1, wherein both of said terminal ends are simultaneously picked out.

3. A method of inserting a terminal according to claim 1, further

comprising the step of inserting the terminals of both terminal ends into different connector housings.

4. A method of inserting a terminal comprising the steps of:

picking out both terminal ends of each of terminal-equipped wires held by a plurality of clips by a pair of terminal insertion heads individually driven;

simultaneously moving both terminal ends of each wire; and

inserting the terminals of both terminal ends into a common connector housing.

5. A terminal insertion apparatus comprising:

at least one Y-axis beam moving along a pair of X-axis beams each having a rack;

a terminal insertion head attached to said Y-axis beam;

a pair of driving motors, each having a pinion toothed with said rack, provided at both ends of said Y-axis beam so that they are driven synchronously to move said Y-axis beam.

6. A terminal insertion apparatus according to claim 5, wherein a pair of Y-axis beams are provided, and a pair of terminal insertion heads are arranged in said pair of Y-axis beams correspondingly.

7. A terminal insertion apparatus according to claim 5, wherein a pair of Y-axis beams are provided, and plural pairs of terminal insertion heads are arranged in said pair of Y-axis beams correspondingly.

8. A terminal insertion apparatus comprising:

a pair of Y-axis beams moving along a pair of X-axis

beams; and

a pair of terminal insertion heads correspondingly  
attached to said pair of  
Y-axis beams and individually driven.



US005774981A

#1

**United States Patent** [19]

Maejima et al.

[11] Patent Number: **5,774,981**[45] Date of Patent: **Jul. 7, 1998**[54] **TERMINAL INSERTION METHOD AND APPARATUS**[75] Inventors: **Takamichi Maejima; Hiroo Suzuki**  
both of Haibara-gun, Japan[73] Assignee: **Yazaki Corporation, Tokyo, Japan**[21] Appl. No.: **744,168**[22] Filed: **Nov. 5, 1996**[30] **Foreign Application Priority Data**

Jul. 11, 1995 [JP] Japan ..... 7-288556

[51] Int. Cl.<sup>6</sup> ..... **H01R 43/04**[52] U.S. Cl. .... **29/861; 29/33 M; 29/753; 29/863**[58] Field of Search ..... **29/33 M, 861, 29/863, 754, 747, 753, 857**[56] **References Cited****U.S. PATENT DOCUMENTS**

5,083,370 1/1992 Koeh et al. .... 29/863  
 5,127,159 7/1992 Kudo et al. .... 29/861 X  
 5,208,977 5/1993 Ricard ..... 29/861  
 5,309,633 5/1994 Ricard ..... 29/33 M X  
 5,315,756 5/1994 Jarjevic et al. .... 29/33 M X  
 5,355,583 10/1994 Osumi et al. .... 29/33 M X  
 5,365,659 11/1994 Ueda et al. .... 29/863  
 5,414,925 5/1995 Nishide et al. .  
 5,477,607 12/1995 Ohta et al. .... 29/33 M X  
 5,515,601 5/1996 Maejima ..... 29/33 M X

5,575,058 11/1996 Nakamura et al. .... 2933 M X  
 5,606,795 3/1997 Ohba et al. .... 29/863  
 5,615,478 4/1997 Celoudoux et al. .... 2933 M X

**FOREIGN PATENT DOCUMENTS**

0 440 955 A1 12/1990 European Pat. Off. .  
 1-313871 12/1989 Japan .  
 5-31683 2/1993 Japan .  
 6-84577 3/1994 Japan .

**OTHER PUBLICATIONS**

Patent Abstracts of Japan, vol. 014, No. 444, Sep. 21, 1990  
 & JP 02 177283 A, Jul. 10, 1990.

Primary Examiner—Carl J. Arbes

Attorney, Agent, or Firm—Armstrong, Westerman, Hattori,  
McLeland & Naughton[57] **ABSTRACT**

Both terminal ends of each of terminal-equipped wires held by clips are simultaneously picked out by a pair of terminal insertion heads individually driven and moved simultaneously moved. Thus, a short terminal-equipped wire can be inserted into different connector housing. In a terminal insertion apparatus comprising a Y-axis beam having a terminal insertion head and moving along a pair of X-axis beams, a pair of driving motors are provided at both ends of said Y-axis beam and are driven synchronously to move said Y-axis beam. Thus, the Y-axis beam is prevented from being vibrated, thereby assuring terminal insertion.

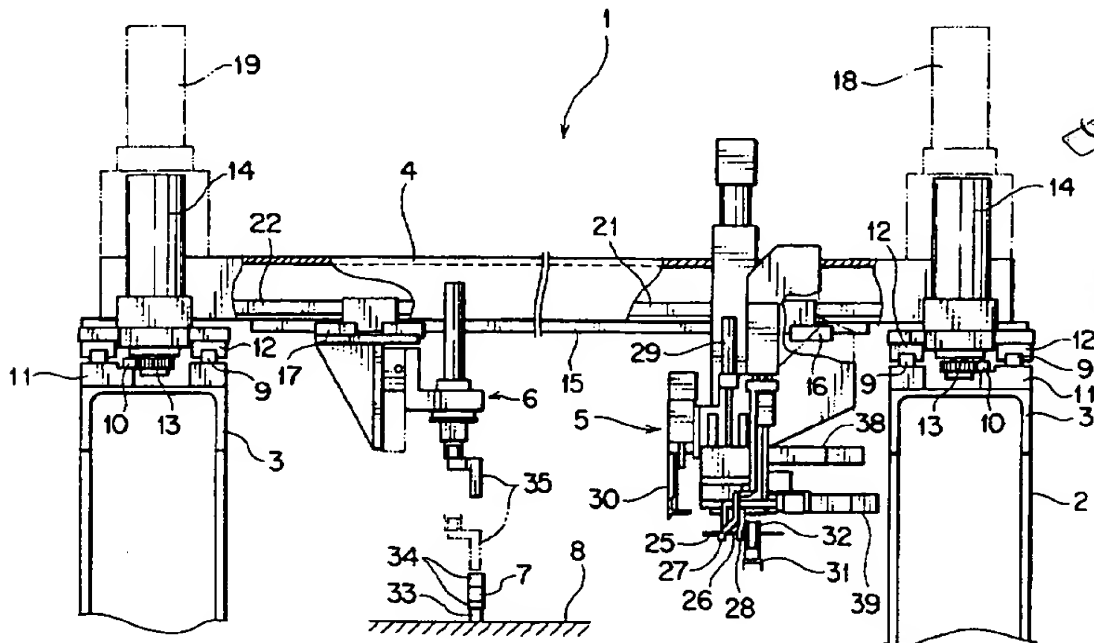
**8 Claims, 5 Drawing Sheets**Connector Rec'd  
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Fig 2

Col. 3: 58

FIG. 1

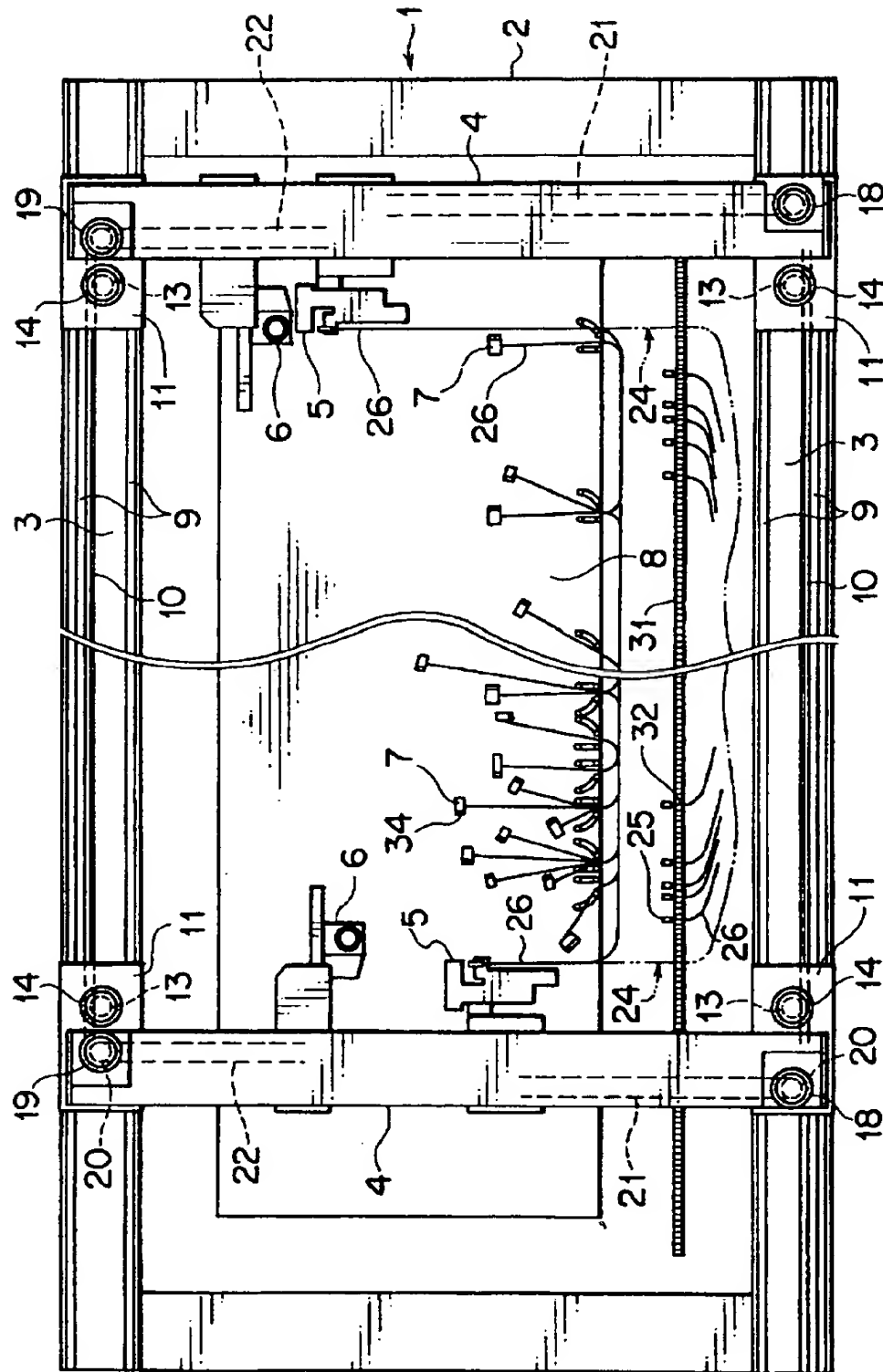




FIG. 2

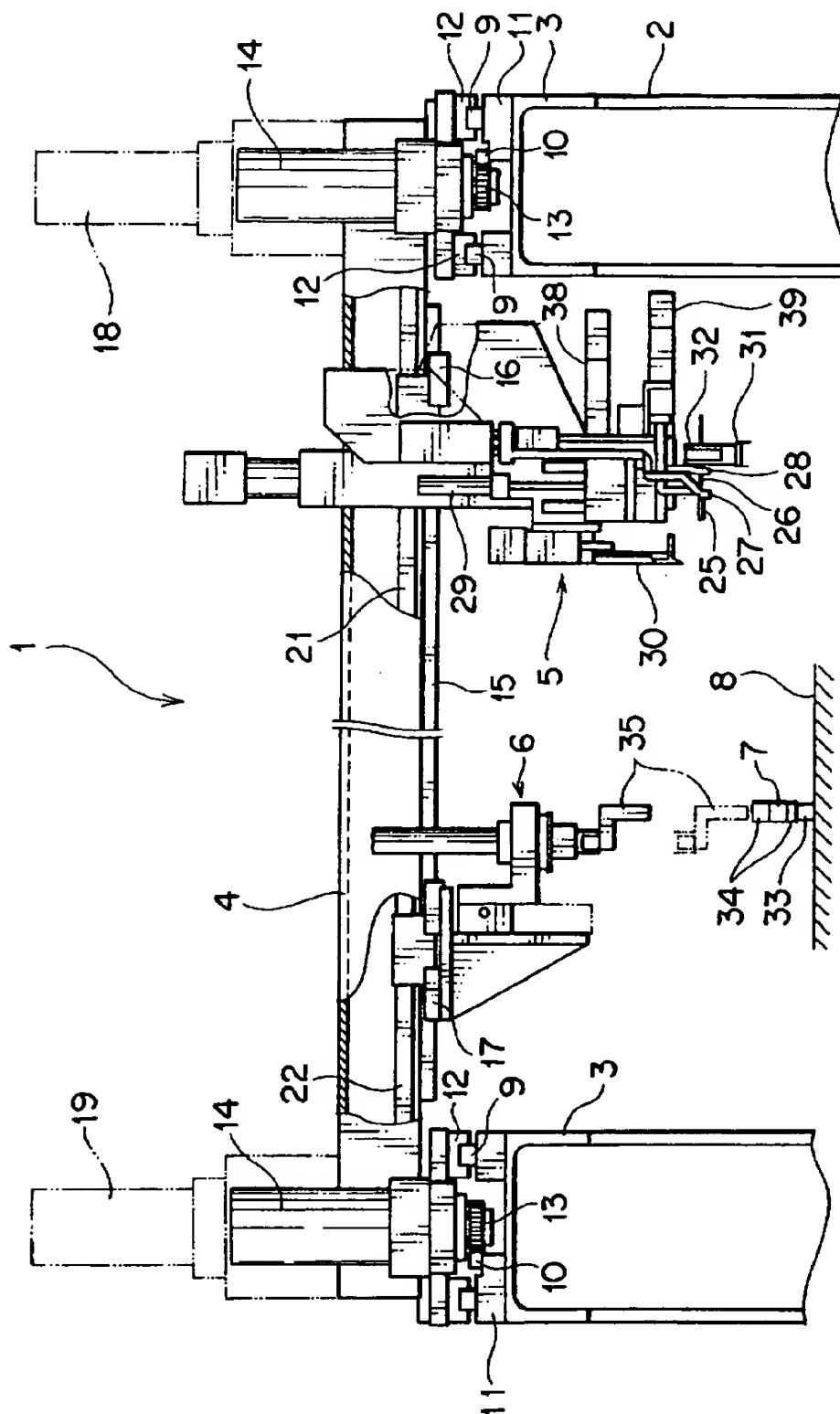


FIG. 3

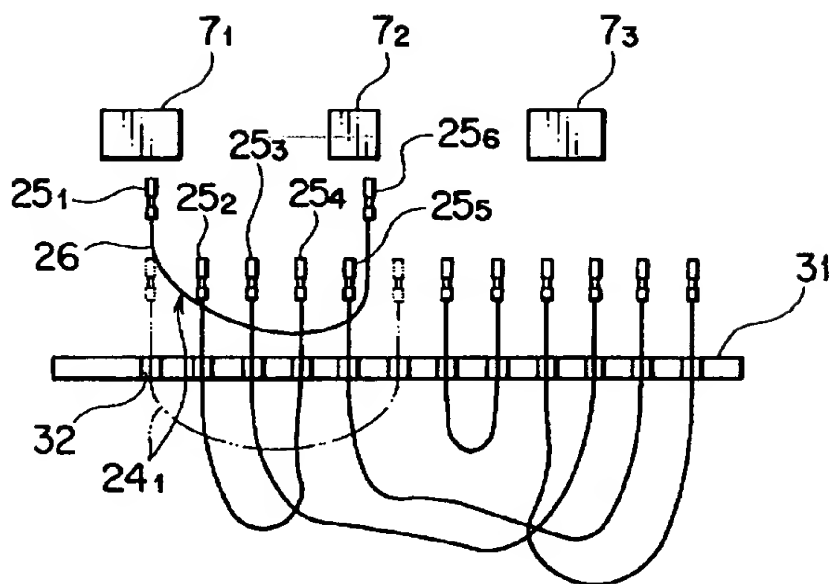


FIG. 4

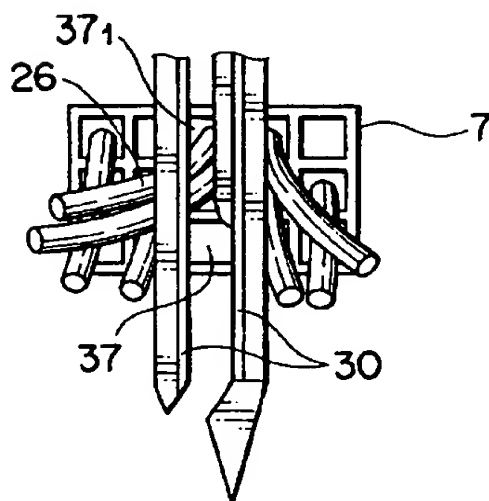


FIG. 5

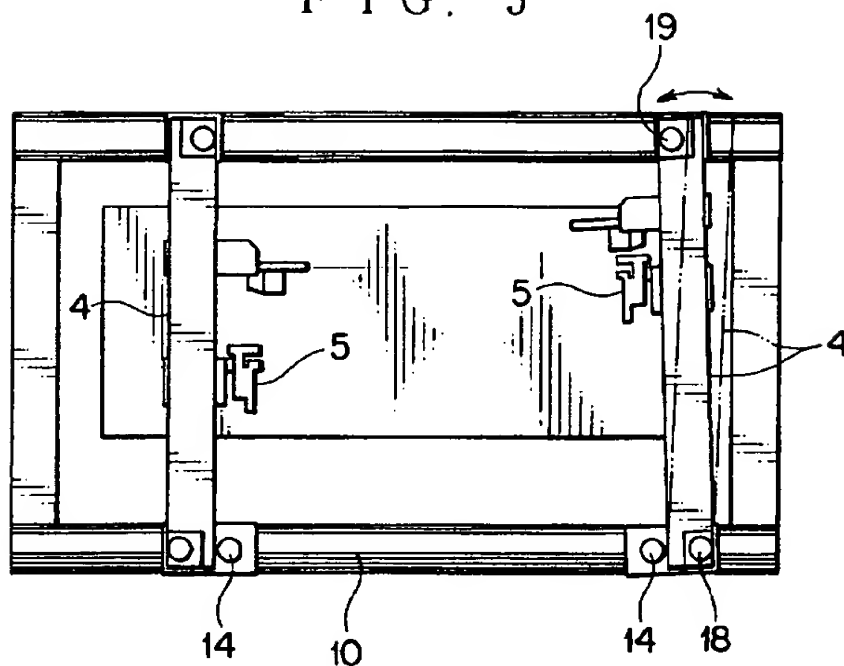
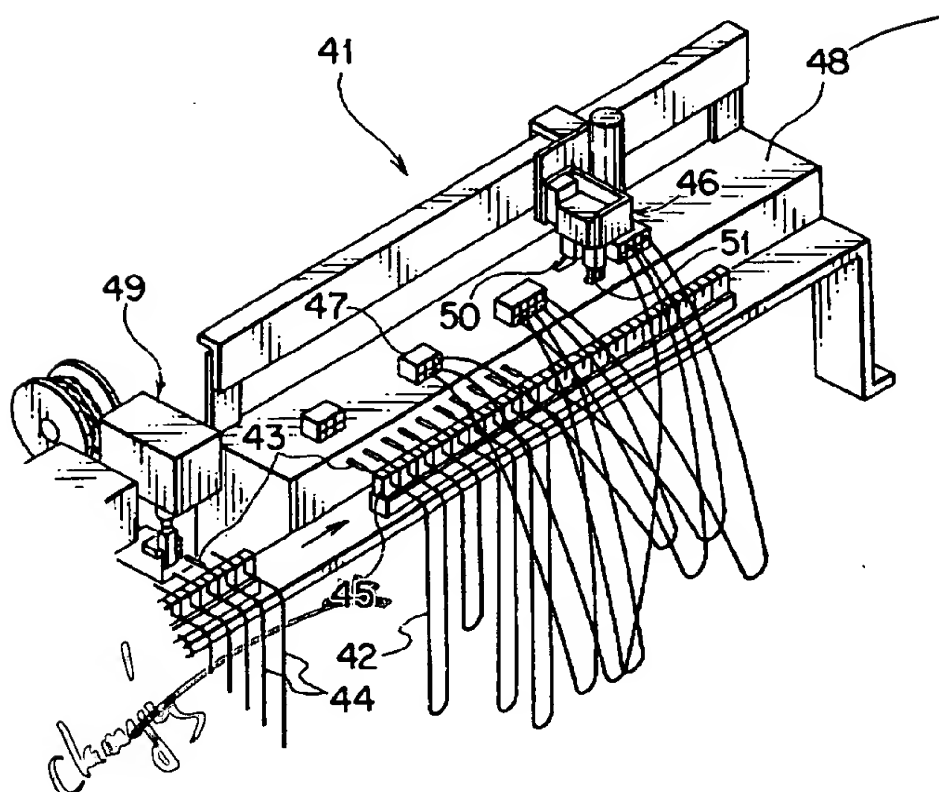
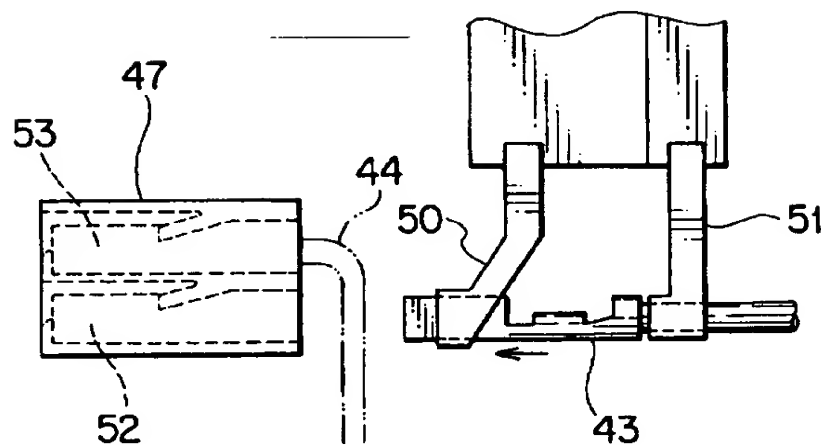
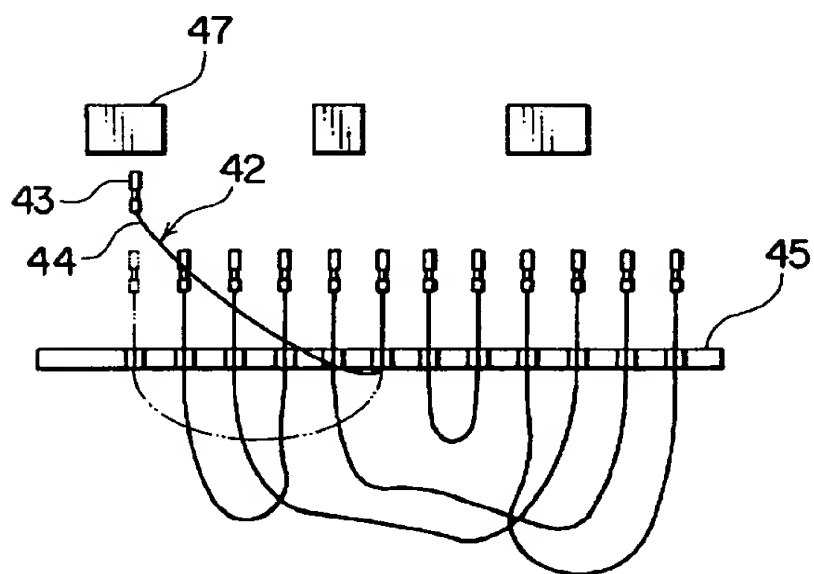
FIG. 6  
PRIOR ART

FIG. 7  
PRIOR ARTFIG. 8  
PRIOR ART

# TERMINAL INSERTION METHOD AND APPARATUS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a terminal insertion method which moves both terminal ends of a terminal-equipped wire to a connector housing(s) simultaneously, and a terminal insertion apparatus for making smooth horizontal movement of a Y-axis beam equipped with a terminal insertion head.

### 2. Description of the Prior Art

FIG. 6 shows a conventional terminal insertion apparatus 41.

This apparatus 41 includes a clamping rod 45 for clamping plural terminal-equipped wires 42 in a U-shape beam state, a terminal insertion head which can move horizontally along the clamping rod 45 and a receiving jig (not shown) for securing connector housings 47 on a stand 48. In a previous step, the terminals 43 held by the clamping rod 45 are crimped on the tips of each wire 44 by a crimping machine 49. The entire clamping rod 45 is sent to a terminal insertion step. The terminal insertion head 46 has a pair of front and rear holding pieces 50 and 51 which can be moved horizontally and vertically.

On the clamping rod 45, the terminal-equipped wires 42 are arranged in the order of insertion. The insertion head 46 takes off the terminal equipped wire 42 from the clamping rod 45 and moves forward to insert the terminal 43 into the connector housing 47. As shown in FIG. 7, the terminals 43 are inserted into lower chambers 52 of the connector housing 47 in order from the end and thereafter into upper chambers 53 thereof in order. This intends to prevent the upper introducing wire 44 from hindering terminal insertion. After the front holding piece 50 makes insertion of the tip of the terminal 43 primarily, it moves upwards to escape. The rear holding piece 51 makes insertion of the entire terminal secondarily.

The above conventional terminal insertion apparatus, however, has the following disadvantage. As shown in FIG. 8, when the one terminal 43 of the single terminal-equipped wire (circuit) 44 is moved towards the connector housing 47 by the terminal insertion head 46, if the wire 44 is short, it is stretched from the clamping rod 45 clamping the other terminal, thus making it impossible to insert the terminal into the connector housing 47. In this case, only the short terminal-equipped wire 42 must be inserted manually, which leads to an increase in the man of hours in the fabrication of a wire harness.

## SUMMARY OF THE INVENTION

In view of the above circumstance, an object of the present invention is to provide a terminal insertion means which can insert a short terminal-equipped wire (circuit) into a connector housing(s) automatically and surely, and also shorten the fabricating time.

In order to attain the above object, in accordance with one aspect of the present invention, there is provided a method of inserting a terminal comprising the steps of: picking out both terminal ends of each of terminal-equipped wires held by a plurality of clips by a pair of terminal insertion heads individually driven; and simultaneously moving both terminal ends of each wire.

In accordance with another aspect of the present invention, there is provided a terminal insertion apparatus

comprising: at least one Y-axis beam moving along a pair of X-axis beams each having a rack; a terminal insertion head attached to said Y-axis beam; a pair of driving motors, each having a pinion toothed with said rack, provided at both ends of said Y-axis beam so that they are driven synchronously to move said Y-axis beam.

In accordance with the present invention, both terminal ends of a single terminal-equipped wire can be moved simultaneously from a clip and terminal-inserted simultaneously so that the wire will not be hung on the clip and so not stretched. Thus, even a short terminal-equipped wire can be inserted automatically. This permits the conventional manual insertion to be abolished and the fabrication time to be shortened.

Further, both ends of the Y-axis beam equipped with the terminal insertion head can be driven simultaneously so that the tilt and/or vibration of the Y-axis beam can be prevented. This permits the terminal to be inserted into the housing accurately.

The above and other objects and features of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the entire terminal insertion apparatus according to the present invention;

FIG. 2 is a side view of the entire terminal insertion apparatus according to the present invention;

FIG. 3 is a plan view showing the manner of moving both terminal ends of a terminal-equipped wire to be inserted into a connector housing(s);

FIG. 4 is a front view of the manner of assuring a required terminal chamber of the connector housing by a wire thrusting piece;

FIG. 5 is a plan view showing the state where the Y-axis beam of the terminal insertion apparatus;

FIG. 6 is a perspective view of a prior art terminal insertion apparatus;

FIG. 7 is a side view of the state where a terminal is inserted into a connector housing; and

FIG. 8 is a plan view for explaining the problem encountered when a short terminal-equipped wire is automatically inserted.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A detailed explanation will be given of embodiments of the present invention.

FIGS. 1 and 2 show a terminal insertion apparatus 1 according to the present invention.

This terminal insertion apparatus 1 includes a pair of X-axis beams 3 hung on a frame 2; a pair of Y-axis beams 4 movably hung on the pair of X-axis beams 3; a terminal insertion head 5 and a connector holding unit 6 movably provided at each of the Y-axis beams 4 and base pallet 8 for securing connector housings 7 below the pair of Y-axis beams 4.

The terminal insertion apparatus 1 has a large size because of X-axis beams having a length of about 5 meters and Y-axis beams having a length of 2 meters. On each of the X-axis beams 3 a single rack 10 is arranged in a longitudinal direction between a pair of guide rails 9 provided on both sides. The guide rails and rack 10 are bolted to the X-axis beam 3, respectively. On both ends of each of the Y-axis

beams 4, guide plates 11 are provided along the X-axis beams 3. Each guide plate 11 includes LM guides 12 corresponding to the guide rails 9 and a driving servo motor (hereinafter simply referred to as driving motor) 14 having a pinion 13 for the rack 10. The LM guide 12 is slidably engaged with the guide rail 9 and the pinion 13 is toothed with the rack 10 so as to roll on the rack by motor driving. The servo-motors 14 on both sides of the Y-axis beam 4 are driven synchronously.

A guide rail 15 is provided on the lower side of each of the Y-axis beams 4. The terminal insertion head 5 and the connector holding unit 6 are slidably engaged with the guide rail 15 by LM guides 16 and 17. On both ends of the Y-axis beam 4, servo motors 18 and 19 are provided for driving the terminal insertion head 5 and the connector holding unit 6. Timing belts 21 and 22 are engaged with pulleys 20 of the servo motors 18 and 19, respectively. The one timing belt 21 and the other timing belt 22 individually drive the terminal insertion head 5 and the connector holding head 6 in the Y-direction, respectively.

The terminal insertion head 5 and the connector holding unit 6 and their driving mechanism have been proposed in JP-A-7-190578 and JP-A-7-203344. In this embodiment, as shown in FIG. 1, the terminal insertion head 5 is attached to each of the pair of Y-axis beams 4. For this reason, both terminal ends (each including the terminal 25 and the wire 26 successive thereto) of a single terminal-equipped wire (circuit) 24 are caught by the terminal insertion heads 5 so that the terminals 25 can be moved toward and inserted into the connector housings 7. The number of the terminal insertion heads 5 should not be limited to two (one pair) but may be an even number (plural pairs) so that both terminal ends of the terminal-equipped wire (circuit) 24 can be processed for their movement and insertion for the connector housing.

As shown in FIG. 2, the terminal insertion head 5 includes front and rear catching pieces 27, 28 for catching the wire 26 successive to the terminal, a primary cylinder 38 for moving both catching pieces 27 and 28 simultaneously in a horizontal direction, a secondary cylinder 39 for individually moving the rear catching piece 28, a vertical cylinder 29 for vertically moving both catching pieces 27, 28 together with the cylinders 38, 39 and a pair of thrusting guide pieces 30 for thrusting the wires 26 introduced from the connector housing 7 ahead of the catching piece 27.

Both terminal ends of each of the plurality of terminal-equipped wires 24 are caught by a plurality of clips 32 on a high speed transporting belt 31 and separately arranged as shown in FIG. 1. A plurality of base jigs 33 (FIG. 2) are secured on the base pallet 8. A connector receiving jig 34 is removably engaged with each base jig 33. The connector housing 7 is held in the connector receiving jig 34. The connector holding unit 6 has a chuck 35 for removing the connector receiving jig 34 which is movable vertically from the base jig 33.

The two terminal insertion heads 5 catch each of the terminal ends of the wire (circuit) 24 from each of the clips on the transfer belt and lift them. As shown in FIG. 3, the insertion heads 5 advance simultaneously and insert the terminals 25 into connector housings 7<sub>1</sub> and 7<sub>2</sub>, respectively. In this case, the insertion heads 5 insert the terminals of the terminal ends into not the same connector housing but two separate connector housings (e.g. 7<sub>1</sub> and 7<sub>2</sub>). Namely, the terminal insertion heads 5 share nearby connector housings. This can reduce the horizontal movement of the terminal insertion heads 5 for the connector housing 7, thus reducing

the time required therefor. Since both terminals are caught and advanced simultaneously, unlike the prior art, the wire will not be hooked over the clip and stretched. Thus, even a short terminal-equipped wire (circuit) 24, can be automatically inserted.

The transporting belt 31 can shift a required terminal end near to the connector housing 7 at a high speed. Incidentally, when the terminal 25 is to be inserted, the receiving jig 34 is caught by the chuck so that the connector housing 7 is located ahead of the wire thrusting pieces 30. After terminal insertion is completed, the connector housing 7 is returned to base jig 33 together with the receiving jig 34 by the chuck 35 (see FIG. 2).

In terminal insertion, as shown in FIG. 4, the wire thrusting pieces 30 thrust the introduced wires 26 around a required terminal chamber 37 of the connector housing 7. Therefore, even after the terminal is inserted into the upper chamber 37<sub>1</sub>, it can be surely inserted into the lower chamber 37. Thus, the terminal 25 can be inserted into a required chamber 37 at random. Unlike the prior art, the terminal ends may not be rearranged in an arrangement order of clips. Further, it is important that the terminals 25<sub>1</sub> and 25<sub>2</sub> of both terminal ends of the single wire 24 can be simultaneously inserted into the connector housings 7<sub>1</sub> and 7<sub>2</sub> at random. In the prior art, in FIG. 3, the terminals 25<sub>1</sub> and 25<sub>2</sub> must be inserted into the connector housing 7<sub>2</sub> in order before the terminal 25<sub>1</sub> is inserted. In accordance with the present invention, no limitation is given for the length of a wire so that as shown in FIG. 1, plural connector housings 7 and many circuits 24 can be developed in a shape of wire harness on the base pallet 8.

Incidentally, unless the terminal insertion heads are not interfered with each other, the terminals 25 of both terminal ends can be inserted simultaneously in the connector housing 7. Since the terminals can be inserted at random, as long as the wire is relatively long, using a single insertion head 5, the one terminal 25 of the wire 24 (circuit) can be inserted and thereafter the other terminal 25 thereof can be inserted.

As described above, the two insertion heads 5 can approach the connector housings 7 by the horizontal movement of the two Y-axis beams (movement along the X-axis beams 3) as shown in FIG. 1. In this case, the Y-axis beams 4 can be driven smoothly with no positional deviation in such a manner that the pinions 13 of the driving motors 14 provided at both ends are toothed with the respective racks 10 of the X-axis rails 3. On other hand, when the driving motors 14 is provided at only the one end of the Y-axis beam 4 as shown in FIG. 5, the Y-axis beam 4 may tilt or may be pinched to vibrate during motor driving. The vibration of the Y-axis beam will be propagated to the insertion head 5 to make the terminal insertion inaccurate.

In order to obviate such inconvenience, in accordance with the present invention, both ends of the Y-axis beam 4 is driven by the driving motors 14. Thus, the position of the terminal insertion head 5 can be defined accurately with no vibration so that the terminal 25 can be surely inserted into the connector housing 7. Further, since the Y-axis beam 4 is not subjected to overload due to e.g. pinching, the Y-axis beam 4 can be driven by the necessary and minimum number of motors and so driven at a high speed.

What is claimed is:

1. A method of inserting a terminal in a connector housing comprising the steps of:

picking out both terminal ends of each of terminal-equipped wires held by a plurality of clips by a pair of terminal insertion heads individually driven in both a Y-axis direction and an X-axis direction; and

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simultaneously moving both terminal ends of each wire into said connector housing.

2. A method of inserting a terminal according to claim 1, wherein both of said terminal ends are simultaneously picked out.

3. A method of inserting a terminal according to claim 1, further comprising the step of inserting the terminals of both terminal ends into different connector housings.

4. A method of inserting a terminal comprising the steps of:

picking out both terminal ends of each of terminal-equipped wires held by a plurality of clips by a pair of terminal insertion heads individually driven;

simultaneously moving both terminal ends of each wire; and

inserting the terminals of both terminal ends into a common connector housing.

5. A terminal insertion apparatus comprising:

at least one Y-axis beam moving along a pair of X-axis beams each having a rack;

a terminal insertion head attached to said Y-axis beam;

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a pair of driving motors, each having a pinion toothed with said rack, provided at both ends of said Y-axis beam so that they are driven synchronously to move said Y-axis beam.

6. A terminal insertion apparatus according to claim 5, wherein a pair of Y-axis beams are provided, and a pair of terminal insertion heads are arranged in said pair of Y-axis beams correspondingly.

7. A terminal insertion apparatus according to claim 5, wherein a pair of Y-axis beams are provided, and plural pairs of terminal insertion heads are arranged in said pair of Y-axis beams correspondingly.

8. A terminal insertion apparatus comprising:

a pair of Y-axis beams moving along a pair of X-axis beams; and

a pair of terminal insertion heads correspondingly attached to said pair of Y-axis beams and individually driven.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO.: 5,774,981  
DATED : July 7, 1998  
INVENTOR(S): MAEJIMA et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page, item  
[30] Please change the priority date to --November 7, 1995--

Signed and Sealed this  
First Day of December, 1998



Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks